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# *Flying Blind*

## *THE POLITICS OF THE U.S. STRATEGIC BOMBER PROGRAM*

Michael E. Brown

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# Contents

# Preface

This is a book about the weapon acquisition process. In it, I look at how American weapon acquisition programs begin and why they turn out the way they do. These are important issues because they affect both national and international security.

The book's empirical foundation is a series of case studies of weapon acquisition in the U.S. strategic bomber program. I examine every major American bomber program of the postwar period, a total of fifteen programs ranging from the B-35 of the 1940s to the B-2 of the 1980s. My focus is weapon acquisition activity that falls within established mission areas. Such mainstream programs have been neglected by most students of weapon acquisition and arms racing because innovative programs, such as the first ballistic missile programs, are more glamorous.

In this study I examine the value of technological, economic, bureaucratic, and strategic explanations about the origins of weapon programs. I find no significant support for technological and economic arguments, which are extremely prominent in the literature on the subject. I find some support for bureaucratic accounts and a great deal of support for strategic explanations of how weapon development efforts begin. Some of our ideas about the driving forces behind the Soviet–American arms race and the American military-industrial complex should therefore be reconsidered.

I also examine competing explanations of the cost, schedule, and performance problems that plague contemporary acquisition efforts in the United States. One school of thought holds that these problems are rooted in the American military's fascination with "high-tech" weapon-

ry. Another school maintains that problems occur when development and production activities are allowed to overlap, that is, when they take place concurrently. Each group is half right: acquisition programs run into trouble when they try to advance technology and employ concurrency at the same time. In the period studied in this book, powerful strategic and bureaucratic forces led American military organizations to set their performance requirements far beyond the state of the art and to push their programs as fast as possible. The result, all too frequently, was disastrous from an acquisition standpoint.

The U.S. Air Force and its predecessors, the Army Air Corps and Army Air Forces, were flying blind when they initiated many of their bomber programs. In many cases, emerging operational threats were far from clear when they set performance requirements for new systems. In addition, the technological possibilities for weapon system development were rarely well understood, because the Air Force decision makers generally failed to make a thorough assessment of the technological horizon before they launched new ventures. They routinely compounded the unknowns their programs faced by setting performance requirements far beyond the state of the art. The Air Force and its predecessors were also flying blind when they imposed concurrency on programs that were intended to make a great leap forward technologically. They rushed headlong into projects that needed to proceed in a more orderly manner. As a result, many bomber programs were acquisition accidents waiting to happen.

For gentle but unflagging encouragement during this project's formative stages, I owe an enormous intellectual and professional debt to Richard Rosecrance and George Quester, both then members of the Department of Government at Cornell University. I also thank Arch Dotson and Woody Kelley, of the same department, who were always generous with their time and energy. John Mearsheimer and Jack Snyder read several drafts and offered the tough critiques only good friends would give. Kim Scheppele wrote forty-five pages of single-spaced comments, which she promises never to publish, on my penultimate draft. Kim also suggested the title; the Air Force and I both thank her. Robert Art, Robert Jervis, and Harvey Sapolsky read the manuscript for Cornell University Press and forced me to tighten up both my analysis and my prose. Stanley Brown, Michael Clough, Jacques Gansler, Thomas McNaugher, Judith Reppy, and Robert Spitzer also read the manuscript at various stages and contributed in important ways. Dora Davey Brown was present at the creation; I hope she is as happy as I am to see the book finished. Renée de Nevers read the manuscript carefully and provided much-needed support as the endgame unfolded. To all my friends and colleagues, I am deeply grateful.



For financial and institutional support, I thank the Peace Studies Program, the Walter S. Carpenter Endowment, the Government Department, and the Center for International Studies, all at Cornell University; the Institute for the Study of World Politics, which gave me a grant to travel to Air Force bases around the country; the U.S. Arms Control and Disarmament Agency, which gave me a Hubert H. Humphrey fellowship; the Foreign Policy Studies Program at the Brookings Institution, where I spent a year researching the case studies and working on the first draft; the Center for Science and International Affairs at Harvard University; the Committee on Research at Vassar College, where I taught for several enjoyable years; the Center for International Affairs at Harvard; the Center for Strategic and International Studies in Washington; and the International Institute for Strategic Studies in London. I am particularly grateful to John Steinbruner at Brookings, Samuel Huntington at Harvard, and François Heisbourg at the IISS for providing stimulating and supportive places to work.

Portions of Chapter 8 originally appeared as "The Strategic Bomber Debate Today," *Orbis* (Summer 1984), and "B-2 or Not B-2: Crisis and Choice in the U.S. Strategic Bomber Programme," *Survival* (July-August 1988). I am indebted to the editors of these journals for permission to use some of that material in this book. I am also indebted to the Smithsonian Institution, the Boeing Company, the U.S. Air Force, and the U.S. Department of Defense for permission to use their photographs.

John Baker allowed me to photocopy his files on the B-1. Karyn McCarthy provided valuable research assistance. Hussain Rafi Mohamed provided professional artwork. Helen Forrest and Kate Wilson, resident computer wizards at the IISS, made special efforts on my behalf and saved me weeks of time, at a minimum. Sheelagh Urbanoviez and Christine Zibas of the IISS spent many hours helping me proofread.

My parents, Florence and Stanley Brown, introduced me to the excitement of learning and taught me the value of education. They have supported me in every way, and I will always be profoundly grateful to them.

Given all this support, one can only wonder what took so long.

Michael E. Brown

*London*

# *Abbreviations*

| | |
|---|---|
| AAC | Army Air Corps |
| AAF | Army Air Forces |
| AFLC | Air Force Logistics Command |
| AFSC | Air Force Systems Command |
| ALCM | air-launched cruise missile |
| AMC | Air Materiel Command |
| AMSA | Advanced Manned Strategic Aircraft project |
| ANP | Aircraft Nuclear Propulsion project |
| ARDC | Air Research and Development Command |
| ASD | Aeronautical Systems Division |
| ATSC | Air Technical Service Command |
| CBO | Congressional Budget Office |
| CRS | Congressional Research Service |
| DD | Directorate of Development |
| DDA | Directorate of Development and Acquisition |
| DDP | Directorate of Development Planning |
| DORDP | Directorate of Operational Requirements and Developme Plans |
| GAO | General Accounting Office |
| GEBO | Generalized Bomber study |
| ICBM | intercontinental ballistic missile |
| NACA | National Advisory Committee for Aeronautics |
| NARS | National Archives and Records Service |
| NDRC | National Defense Research Committee |
| NEPA | Nuclear Energy for Propulsion Aircraft project |

| | |
|---|---|
| RAF | Royal Air Force |
| SAC | Strategic Air Command |
| SAM | surface-to-air missile |
| SLBM | submarine-launched ballistic missile |
| TAC | Tactical Air Command |
| USAF | United States Air Force |
| VDT | variable discharge turbine |
| WADC | Wright Air Development Center |

# A Note on Sources

The data for these case studies came from five main sources: (1) declassified Air Force documents and studies; (2) aerospace industry documents and studies; (3) interviews with policy makers and program participants; (4) congressional hearings and reports; and (5) trade journals and the secondary literature. Together, these sources provided a detailed record of the historical period examined in this book, and they kept the case studies from becoming dependent on any single source of information.

Some of the most interesting information in the case studies came from approximately 3,000 pages of classified Air Force memoranda, reports, conference minutes, requirements statements, and command histories. Most of this material was declassified by the Air Force before I began my research, but I also obtained approximately 750 pages of classified documents through the Freedom of Information Act. The Air Force gave me complete access to its classified archives; I was allowed to sift through its historical records before submitting the documents I needed for a declassification review. This access proved to be a double-edged sword. It allowed me to satisfy myself that no archival stone had been left unturned and no filing cabinet left unopened. On the other hand, it took sixteen months to examine all the relevant files held at several widely scattered locations. The Air Force's Office of Security Review withheld no photocopied document from me, although it edited some of the notes I took from classified documents with a pair of scissors; information deleted from these notes was not central to this study. Documents were examined and collected at the following locations:

Modern Military Records Branch, National Archives and Records Service, Washington, D.C.

Simpson Historical Research Center, Air University, Maxwell Air Force Base, Alabama.

Office of Air Force History, Bolling Air Force Base, Washington, D.C.

History Office, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio.

History Office, Air Force Systems Command, Andrews Air Force Base, Maryland.

History Office, Air Force Logistics Command, Wright-Patterson Air Force Base, Ohio.

History Office, Air Force Museum, Wright-Patterson Air Force Base, Ohio.

History Office, National Air and Space Museum, Washington, D.C.

Access to aerospace industry records was uneven. Rockwell's and Northrop's historical files were not open to the general public for proprietary reasons. Several General Dynamics executives were kind enough to give me copies of documents and historical studies from their personal files, but corporate files, again, were not open to the public. Boeing allowed me to examine its extensive and well-organized files on every program it had been involved in since the 1930s. Since Boeing was involved in most air force bomber programs in one way or another, these archives proved to be extremely valuable.

Archival material was supplemented by approximately forty interviews with program participants including military and civilian decision makers as well as engineers and executives from Boeing, Rockwell, and General Dynamics. These interviews lasted from one to five hours. All interviewees were guaranteed anonymity and assured that they would not be quoted directly in this book. This guarantee seemed to encourage forthrightness.

Annual congressional authorization and appropriations hearings conducted by the House and Senate Armed Services and Appropriations committees were useful, as were special hearings focused on specific programs. Committee reports and studies conducted by the Congressional Budget Office, the Congressional Research Service, and the General Accounting Office tended to be more detailed and better organized.

The trade press provided a wealth of technical information, although plowing through years (in some cases, decades) of unindexed journals was frequently tedious. The most useful trade journals were *Aerospace Daily, Armed Forces Journal International, Aviation Week* (now known as *Aviation Week and Space Technology*), *Defense Electronics, Defense News, Defense Systems Review, Defense Week, Flight International, International Defense Review, Jane's Defence Weekly,* and *Space/Aeronautics.*

*Flying Blind*

# [1]

# *Introduction*

In this book I analyze the origins and outcomes of weapon acquisition programs.[1] A thorough understanding of these issues is essential to the promotion of both national and international security.

The origins of weapon acquisition programs are important because those driven by parochial bureaucratic or commercial interests rarely serve national interests well. Unneeded weapons inevitably divert resources from legitimate military programs as well as vital social and economic activities. National security can be undermined as a result: directly, because deployment of the wrong kinds of weapons can weaken a nation's deterrent posture or lead to disaster on the battlefield; indirectly, because excessively high levels of defense spending can affect a nation's long-term economic competitiveness.[2]

The initiation of a weapon development program can also lead other powers to engage in weapon development efforts, creating an arms race. Arms races are always expensive propositions, and they can generate dangerous instabilities. At a minimum, they raise the level of tension between and among states. More ominously, if one of the participants in an arms race believes that the balance of power is moving against it,

1. The weapon acquisition process includes several distinct activities: research, development, production or procurement, and deployment. I use the term "acquisition" to denote the process as a whole and "development" and "production," for example, to refer to more specific sets of activities.

2. The impact of high levels of defense spending on a nation's long-term international position is analyzed in Richard Rosecrance, *The Rise of the Trading State* (New York: Basic Books, 1986); Paul Kennedy, *The Rise and Fall of the Great Powers* (New York: Random House, 1987).

incentives for preventive war may be created. If an arms race features weapons that favor preemptive or offensive action, crisis instabilities may be aggravated.[3]

Finally, it is essential to understand how weapon development programs begin because they acquire a momentum quickly and become difficult to cancel. Policy makers consequently do not have as much control over the acquisition pipeline as they should, and arms races tend to be difficult to control.

Program outcomes are important as well. Technologically advanced programs aggravate qualitative arms races, which have proven to be especially difficult to control because it is hard to devise and verify limitations on the technical characteristics of weapons. Fast-paced programs can accelerate arms races and overwhelm slow-moving arms control negotiations.

The outcomes of weapon acquisition programs also have serious national security implications. Most weapon programs in the United States, for example, are plagued by a pernicious combination of cost overruns, schedule slippages, and performance deficiencies. When unit costs climb, production runs are scaled back to control total program costs. As a result, fewer weapons are bought for the force structure. When programs are delayed, weapons enter the force structure later than expected. They consequently face a more formidable operational environment than they otherwise would have, which impinges on their effectiveness in the short run and makes them obsolete sooner. Finally, when weapons fail to meet their performance specifications, the operational effectiveness of the force structure is weakened. Long-term acquisition trends in the United States are ominous. Each new generation of weapons takes longer to develop and costs more than its predecessor. If current cost and budgetary trends continue, it has been estimated that the Department of Defense will be able to afford only one new aircraft in the year 2054.[4]

Unfortunately, the origins and outcomes of weapon acquisition programs are poorly understood, because existing explanations tend to be

3. For a discussion of the risks and dangers associated with arms races, see Samuel P. Huntington, "Arms Races: Prerequisites and Results," in Robert J. Art and Kenneth N. Waltz, eds., *The Use of Force* (Boston: Little, Brown, 1971), pp. 365–401; Colin S. Gray, "The Arms Race Phenomenon," *World Politics* 24 (Oct. 1971), 39–79. For a through overview of the literature on preventive war, see Jack S. Levy, "Declining Power and the Preventive Motivation for War," *World Politics* 40 (Oct. 1987), 82–107. The relationship between offensive military capabilities and crisis instability is analyzed in George H. Quester, *Offense and Defense in the International System* (New York: Wiley, 1977); Robert Jervis, "Cooperation under the Security Dilemma," *World Politics* 30 (Jan. 1978), 167–214; Stephen W. Van Evera, *The Causes of War* (Ph.D. Dissertation, University of California at Berkeley, 1984), chaps. 1–3.

4. See the discussion in Jacques S. Gansler, *Affording Defense* (Cambridge: MIT Press, 1989), pp. 169–179.



narrow and contradictory. My main goal in this book, therefore, is to test the validity of existing theories about weapon acquisition and to develop integrated explanatory frameworks for analyzing both the origins and the outcomes of weapon acquisition programs. To do this, I address two main sets of questions. First, how do weapon development programs begin? Where do the ideas for these programs originate? What triggers the process in the first place? Second, why do programs turn out the way they do? Why do many push the technological state of the art and move at a fast pace? How do they acquire momentum? Why are some contemporary programs successful in meeting their cost, schedule, and performance targets while most are strikingly unsuccessful?

In attempting to answer these questions, I analyze in detail the fifteen major U.S. strategic bomber programs of the postwar period: the B-35, B-36, B-45, B-46, B-47, B-48, B-49, B-52, B-58, B-60, nuclear-powered bomber, B-70, B-1, B-1B, and B-2.[5] These programs, none of which has been the subject of serious scholarly examination, are grouped into six case studies.[6] Others—including fighter, helicopter, tank, and missile programs—are discussed in passing, primarily in the later stages of the book.

## Program Origins

Political philosophers and international relations theorists have long debated the causes of state behavior.[7] In recent years, the debate has been carried by those who focus on the external or systemic determinants of state behavior, on the one hand, and those who focus on the internal or domestic determinants of state action, on the other. Within this debate, four main arguments—one systemic, three domestic—have

5. Some of these programs had their origins during World War II. Obviously, some bombers are missing from this numerical sequence. The B-38 and B-40, for example, were modified versions of the B-17, which was designed and built in the 1930s and produced in quantity during the war. Similarly, the B-39, B-44, B-50, and B-54 were advanced versions of the B-29, another World War II bomber. The B-42, B-43, B-51, B-53, B-57, and B-66 were tactical bombers; their range and payload capabilities were not suitable for strategic missions. The B-55 and B-59 were simply design studies. Finally, many "bomber numbers" were assigned to missile projects. Examples include the B-61 (Matador), B-62 (Snark), B-63 (Rascal), B-64 (Navaho), B-65 (Atlas), B-68 (Titan), B-72 (Quail), B-75 (Thor), B-77 (Hound Dog), B-78 (Jupiter), B-80 (Minuteman), and B-87 (Skybolt). After the cancellation of the B-70 in the early 1960s, the Air Force broke with the past and began renumbering its bomber programs; hence, the B-1 was the successor to the B-70.

6. The method of comparative case study is outlined in Alexander L. George, "Case Studies and Theory Development: The Method of Structured, Focused Comparison," in Paul Gordon Lauren, ed., *Diplomacy* (New York: Free Press, 1979), pp. 43–68.

7. The classic survey of this debate is found in Kenneth N. Waltz, *Man, the State, and War* (New York: Columbia University Press, 1959).

been advanced to explain military policy in general and, more specifically, the origins of weapon acquisition programs: strategic explanations, bureaucratic explanations, economic explanations, and technological explanations.[8]

### *Strategic Explanations*

Strategic explanations, which include balance-of-power theories and realist accounts of international relations, maintain that the wellspring of state behavior is the character of the international system within which states operate.[9] According to this line of argument, the most important characteristic of the international system is its anarchic nature; since national security cannot be guaranteed by enforceable international laws or any supranational agency, states must look to their own devices to safeguard or promote vital national interests. As a result, states are said to be acutely aware of international developments that have the potential to change the global balance of power and adversely affect national security. In theory, any of the following developments could disrupt the balance and pose a threat to national security: the emergence of a new adversarial (or potentially adversarial) power; the formation of a new adversarial (or potentially adversarial) alliance; the expansion of an adversary's power through conquest, alliance, or devotion of more resources to military activities; the appearance of new military technologies or weapon systems in an adversary's arsenal; the collapse or defeat of a friendly power; a withdrawal from or disintegration of friendly alliance structures; or a military defeat that reduces access to vital natural resources or forward bases or leads to the loss of territorial buffers.

States can respond to changing strategic conditions such as these in one of two basic ways. One option is external: they can try to form new alliances or augment existing ones. The other option is internal: they can devote more national resources to military activities.[10] Changing strategic circumstances might therefore lead policy makers to initiate new weapon development programs.

8. Many have argued that a state's internalized foreign policy goals are instrumental in shaping its international behavior. In particular, some states have expansionistic, aggressive foreign policies or foreign policies guided by missionary ideologies of one kind or another. Aggressive states such as these might initiate military programs in order to intimidate opposing states or to prepare for conquest. Although several internal determinants of policy are analyzed in this book, explaining the behavior of genuinely malignant states such as Nazi Germany is beyond the scope of this study.

9. See Waltz, *Man, the State, and War*, chap. 6; Waltz, *Theory of International Politics* (Reading, Mass.: Addison-Wesley, 1979), chap. 6; Hans Morgenthau, *Politics among Nations* (New York: Knopf, 1978); Barry R. Posen, *The Sources of Military Doctrine* (Ithaca: Cornell University Press, 1984), pp. 59–67.

10. Posen, *Sources of Military Doctrine*, pp. 61–63.



Samuel Huntington has observed that internal balancing mechanisms have assumed greater importance over the course of the past hundred years because (1) the number of great powers in the system (that is, the number of potential alliance partners) has declined; (2) forces-in-being have become more important than territory for national security; and (3) the industrial and technological capacities of states have increased significantly.[11] Barry Posen has argued that politically isolated states and superpowers are especially reliant on internal balancing mechanisms, in the first case, because allies are difficult to find and, in the second, because alliances with smaller powers are not likely to enhance a superpower's security position substantially.[12]

Balance-of-power theorists would argue that, since both the United States and the Soviet Union were highly dependent on internal balancing mechanisms during the Cold War, the most likely response to the appearance of a new weapon on one side was deployment of a new weapon on the other. This response could take the form of a weapon designed to counter or neutralize the other's new weapon, thereby restoring the operational balance. Alternatively, the responder could match the initiator and build a similar kind of weapon,[13] allowing him to claim that the force structures of the two sides were still comparable and providing him with a useful bargaining chip for arms control negotiations. Many Soviet and American weapon decisions, it is said, can be explained by this "action-reaction" process.[14]

Since it generally takes five to fifteen years to develop, produce, and field a weapon system, each superpower was reluctant to wait until its adversary deployed a new weapon before initiating an appropriate response; neither wanted to be confronted by a long and potentially dangerous capabilities gap or window of vulnerability. So, each superpower tried to anticipate what the other had in the acquisition pipeline and respond accordingly. Therefore, it might be more accurate to characterize this interactive process as an "anticipation-reaction" process, where reactions are driven by discrete developments as well as nagging strategic uncertainties. Former U.S. Secretary of Defense Robert

11. As a result, arms races have become more frequent since the early nineteenth century; see Huntington, "Arms Races," pp. 367–372.

12. Posen, *Sources of Military Doctrine*, pp. 61–67.

13. Graham T. Allison (who is not known as a balance-of-power theorist) discusses these arguments in "Questions about the Arms Race: Who's Racing Whom? A Bureaucratic Perspective," in Robert Pfaltzgraff, ed., *Contrasting Approaches to Strategic Arms Control* (Lexington, Mass.: Lexington Books, 1974), pp. 31–72.

14. In discussing the Soviet–American arms race, Herbert York and G. Allen Greb argued that the action-reaction cycle "played a very fundamental role in determining the course of events"; see "Military Research and Development: A Postwar History," *Bulletin of the Atomic Scientists* 33 (Jan. 1977), 13.

McNamara explained: "What is essential to understand here is that the Soviet Union and the United States mutually reinforce one another's strategic plans. Whatever their intentions or our intentions, actions—or even realistically potential actions—on either side relating to the build-up of nuclear forces necessarily trigger reactions on the other side."[15]

Some would argue that, given the uncertainties inherent in the intelligence process and the tendency of policy makers to make worst-case assumptions about the military capabilities of adversaries, weapon development decisions are driven by an "anticipation-overreaction" process, where each overreaction feeds successive rounds of overreactions.[16] Although this chain of events might produce an arms race that serves neither side's interests well, the process would nonetheless be driven by legitimate national security concerns which grow out of developments in the strategic arena.

### *Bureaucratic Explanations*

Strategic and balance-of-power explanations have been criticized on several grounds over the past twenty-five years, mainly because they neglect the internal determinants of state behavior. One of the most prominent critiques of balance-of-power theory argues that one cannot understand state behavior without understanding the important role that bureaucracies play in the policy-making process.

Bureaucratic-politics analysts maintain that it is inaccurate to characterize state behavior as purposive and policy making as a rational process of analysis and choice designed to maximize national interests and goals. They argue that policy is the product of a political process of pulling and hauling among bureaucratic players with different interests, different stakes in different issues, and varying amounts of influence

15. Robert McNamara, *The Essence of Security* (New York: Harper and Row, 1968), pp. 58–59. Similarly, George Rathjens has written that "the action-reaction phenomenon, with the reaction often premature and/or exaggerated, has clearly been a major stimulus of the strategic arms race"; see "The Dynamics of the Arms Race," in Bruce M. Russett and Bruce G. Blair, eds., *Progress in Arms Control?* (San Francisco: Freeman, 1979), p. 37.

16. Albert Wohlstetter has argued that the United States routinely underestimated Soviet strategic force levels in the 1960s, but he does not dispute that U.S. decisions were influenced by intelligence projections about Soviet capabilities. For more on the over-estimation/underestimation debate, see Wohlstetter, "Is There a Strategic Arms Race?" *Foreign Policy* no. 15 (Summer 1974), 3–20; Wohlstetter, "Rivals, but No Race," *Foreign Policy*, no. 16 (Fall 1974), 48–81; Michael Nacht, "The Delicate Balance of Error," *Foreign Policy*, no. 19 (Summer 1975), 163–177; Wohlstetter, "Optimal Ways to Confuse Ourselves," *Foreign Policy*, no. 20 (Fall 1975), 170–198.





over the outcomes of these internal negotiations. It is especially important, they argue, to recognize that parochial bureaucratic interests can differ substantially from national interests broadly defined.[17] According to Morton Halperin, core bureaucratic interests include preserving main missions; expanding mission capabilities; enlarging departmental budgets; increasing organizational autonomy from central authorities; improving organizational morale by staying involved in activities of national importance and by providing attractive career prospects; and increasing the organization's political influence, which allows it to pursue all its goals more effectively.[18] Strategic bombardment, for example, is a core mission of the U.S. Air Force, one that has defined its essence since its inception. Bureaucratic-politics analysts would consequently predict that the Air Force would place a high priority on having bomber projects in the acquisition pipeline whenever possible.

Bureaucratic-politics analysts would also predict that military organizations tend to be highly successful in defending core missions and promoting institutional interests. Military organizations are powerful because they have large budgets and because they supervise many large acquisition programs. As a result, the American military, for example, has influential constituents in industry and labor as well as loyal allies in Congress. In addition, the military services in the United States rarely challenge the core missions of the other services, and civilian policy makers frequently defer to the military's professional judgment on defense issues. As a result, many scholars, including several who cannot be characterized as bureaucratic-politics analysts, have concluded that military organizations play a decisive role in shaping national policy. Robert Heilbroner, for example, has argued that the military is "a self-contained entity, capable of impressing its views and imposing its will not only on the civil establishment to which it pays ritual obeisance, but over a section of the economy in which the language of private enterprise is merely a fiction to hide its absolute authority." John Kenneth Galbraith has concluded that "the military services, not their industrial suppliers, are the prime wielders of . . . power" in the military-industrial complex, and that, because of their high degree of depen-

17. Graham T. Allison, *Essence of Decision* (Boston: Little, Brown, 1971), chap. 5; Graham T. Allison and Morton H. Halperin, "Bureaucratic Politics: A Paradigm and Some Policy Implications," *World Politics* 24 (Spring 1972), 40–79. The best survey of the bureaucratic-politics literature is found in Robert J. Art, "Bureaucratic Politics and Foreign Policy: A Critique," *Policy Sciences* 4 (Dec. 1973), 467–490. For a pointed critique of bureaucratic-politics analyses, see Stephen D. Krasner, "Are Bureaucracies Important? (Or Allison Wonderland)," *Foreign Policy*, no. 7 (Summer 1972), 159–179.

18. Morton Halperin, *Bureaucratic Politics and Foreign Policy* (Washington: The Brookings Institution, 1974), chap. 3.

dence on defense contracts, many companies are "captive contractors" of different military services.[19]

Moreover, because they are relatively permanent fixtures on the policy-making scene, military organizations are said to play a particularly important role in shaping weapon acquisition programs. According to Graham Allison and Frederic Morris, "the services and their subunits are the primary actors in weapon development. Consequently, force posture is shaped by the goals and procedures and especially the missions and weapon systems to which services (and subunits) are committed. Political officials might disturb this process; only rarely do they control it."[20]

Bureaucratic-politics analysts, therefore, expect military organizations to play the leading role in initiating most weapon development programs. The mainstream commands of the services are expected to take the lead within established mission areas, while bureaucratic entrepreneurs, mavericks, insurgents, and separatists are expected to take the lead in areas where no established mission exists.[21] In the case of the former, the military is expected to build weapons designed to implement existing operational doctrines. In the case of the latter, operational doctrines might not yet be well formed. But, in each case, the military's motivation is promoting bureaucratic interests rather than responding to strategic developments.

### *Economic Explanations*

Another school of thought on the military-industrial complex argues that the military plays a secondary and essentially reactive role in the policy-making process. Gabriel Kolko, for example, has stated that the military tends to be "docile" and that it is "unquestionably among the most restrained of those in power."[22] According to this line of think-

19. Heilbroner and Galbraith quoted in Charles C. Moskos, Jr., "The Concept of the Military-Industrial Complex: Radical Critique or Liberal Bogey?" *Social Problems* 21 (April 1974), 503.

20. Graham Allison and Frederic Morris, "Armaments and Arms Control: Exploring the Determinants of Military Weapons," in Franklin A. Long and George W. Rathjens, eds., *Arms, Defense Policy, and Arms Control* (New York: Norton, 1976), p. 123. See also Allison, "Questions about the Arms Race," pp. 42–51; Morton H. Halperin, "The Decision to Deploy the ABM: Bureaucratic and Domestic Politics in the Johnson Administration," *World Politics* 25 (Oct. 1972), 62–95.

21. For more discussion of the roles played by bureaucratic entrepreneurs and insurgents in promoting new programs, see Vincent Davis, *The Politics of Innovation: Patterns in Navy Cases* (Denver: University of Denver, Graduate School of International Studies Monograph, 1967); Frederic A. Bergerson, *The Army Gets an Air Force* (Baltimore: Johns Hopkins University Press, 1980).

22. Kolko quoted in Moskos, "Concept of the Military-Industrial Complex," p. 506; see also pp. 498–512.





ing, the driving force behind defense policy in general and weapon acquisition in particular is the defense industry, which in turn is driven by its own economic interests.[23]

Many American companies, to be sure, have long been dependent on defense contracts.[24] Some analysts argue that, because of compelling economic interests, defense contractors have generally been responsible for initiating new weapon development programs. According to this line of analysis, most contractors invest a great deal of time and money on research and development activities of their own, in the hope that fundable projects might come out of their laboratories and engineering shops. When interesting ideas are generated, they are passed along to the appropriate military service, which is usually interested in pursuing them for parochial reasons of its own. Later, corporate wealth and influence are said to play a role in securing support for programs at higher levels in the executive branch, Congress, and the media. As one corporate executive put it, the military "depends on companies like ours to tell them what they need."[25] Another executive observed:

> At the aircraft corporation where I worked as an engineer for many years, military contracting seemed related not so much to national security as to corporate security. . . . It is the armed services who are the customers, and it is their interest which must be stimulated. Certain segments of the work force, therefore, are assigned to discover new "ventures." An improved version of an existing weapon or even something dramatically new may be proposed to the military by the defense-supported contractor. . . . The reason for all these new weapons and weapon systems is the profit motive, a matter of keeping business going rather than of protecting the country.[26]

J. Ronald Fox argued in his examination of American weapon acquisition that "defense contractors are profoundly influential in the origination and development of new program ideas."[27] Mary Kaldor concluded that

23. See, for example, Paul A. Baran and Paul M. Sweezy, *Monopoly Capital* (New York: Monthly Review, 1966); "No Business like War Business," *The Defense Monitor* 16 (1987), 1–8. Historical analyses of the U.S. military-industrial complex can be found in Benjamin Franklin Cooling, ed., *War, Business, and American Society* (Port Washington, N.Y.: Kennikat Press, 1977). For a comparative perspective, see Cooling, ed., *War, Business, and World Military-Industrial Complexes* (Port Washington, N.Y.: Kennikat Press, 1981).

24. For a dispassionate analysis of the U.S. defense industry's dependence on defense contracts, see Jacques S. Gansler, *The Defense Industry* (Cambridge: MIT Press, 1980), chaps. 2–3. See also the comparative case studies in Nicole Ball and Milton Leitenberg, eds., *The Structure of the Defense Industry* (New York: St. Martin's, 1983).

25. Quoted in Mary Kaldor, *The Baroque Arsenal* (New York: Hill and Wang, 1981), p. 69.

26. Robert C. Aldridge, "How Defense Industries Keep the Business Coming," *Bulletin of the Atomic Scientists* 32 (May 1976), 44–46.

27. J. Ronald Fox, *Arming America* (Boston: Harvard University, Graduate School of Business Administration, 1974), p. 101.

the existence of large corporations which are dependent on government contracts creates an "industrial imperative" for new weapon development programs in the United States.[28]

James Kurth has argued that new development and production contracts tend to be awarded to important contractors whenever old contracts are about to expire or be canceled. Similarly, new contracts tend to be awarded to important contractors who are on the brink of bankruptcy. Strategic and bureaucratic explanations for what he calls the "follow-on imperative" and the "bail-out imperative" are unsatisfactory, in his view. Kurth maintains that economic considerations play a central role in decisions about contract awards.[29]

### *Technological Explanations*

A final argument about the origins of weapon development programs emphasizes the importance of technological factors in the decision-making process. According to this argument, the original impetus for weapon development is the emergence of new discoveries in laboratories, which communicate word of their technological breakthroughs to the military. The military, it is said, reacts to this news by devising military rationales and requirements for these technologically irresistible ideas. Once rationales have been devised, the military lobbies for funding and political support. Programs build up momentum as time goes by and eventually move into full-scale development and production. Because the ideas that emerge from weapons laboratories are so irresistible, a "technological imperative" is often said to be behind the origins of weapon development programs and the arms race itself.

This argument has been extremely prominent for decades. In their classic study of the American weapon acquisition process, Morton Peck and Frederic Scherer concluded that the precipitating factor in a decision to develop a new weapon system is usually a technical or scientific discovery.[30] Solly Zuckerman, former chief science adviser to the British Ministry of Defence, has elaborated on the same theme. "Ideas for a new weapon system derive in the first place, not from the military, but from different groups of scientists and technologists," he wrote, and

28. Mary Kaldor, "The Weapons Succession Process," *World Politics* 38 (July 1986), 595.

29. See James R. Kurth, "A Widening Gyre: The Logic of American Weapons Procurement," *Public Policy* 19 (Summer 1971), 373–404; Kurth, "Why We Buy the Weapons We Do," *Foreign Policy*, no. 11 (Summer 1973), 33–56. Arnold Kanter and Stuart Thorson argue that several other factors are more important in production decisions than follow-on imperatives; see "The Weapons Procurement Process: Choosing among Competing Theories," *Public Policy* 20 (Fall 1972), 479–520.

30. Morton Peck and Frederic Scherer, *The Weapons Acquisition Process* (Boston: Harvard University, Graduate School of Business Administration, 1962), p. 226.





went on to point out that "military chiefs, who by convention are a country's official advisors on national security, as a rule merely serve as the channel through which the men in the laboratories transmit their views."[31] John Steinbruner and Barry Carter have observed that military requirements come out of "a process that is driven by technical and scientific developments. A major advance in technology in itself provides the impetus for applying it to a weapon; military requirements tend to flow from that, rather than from a prior judgment of actual need."[32]

In short, technological explanations of weapon acquisition and arms racing emphasize the roles played by scientists and engineers. Although scientists and laboratories might have a vested interest in promoting their technological breakthroughs, the discoveries themselves are held responsible for triggering the weapon development process. It is no exaggeration to say that this line of thinking constitutes the conventional wisdom on the subject in the arms control and scientific communities.[33]

### *Analyzing the Origins of Weapon Acquisition Programs*

Many analysts combine several lines of argumentation in their studies of weapons issues. Unfortunately, their analysis generally becomes muddled as a result. For example, in addition to emphasizing action-reaction processes in his analysis of arms races, George Rathjens notes that "the simple desire to bring to fruition an interesting and elegant technological concept is also important."[34] Similarly, Hans Morgenthau, who is known far and wide as one of the leading proponents of realism, has written that the nuclear arms race is driven by technological devel-

31. Solly Zuckerman, *Nuclear Illusion and Reality* (New York: Viking, 1982), pp. 103, 105.

32. John Steinbruner and Barry Carter, "Organizational and Political Dimensions of the Strategic Posture: The Problems of Reform," in Long and Rathjens, eds., *Arms, Defense Policy, and Arms Control*, p. 143.

33. To get a sense of how prominent this argument is, see Hugh E. DeWitt, "Labs Drive the Arms Race," in Len Ackland and Steven McGuire, eds., *Assessing the Nuclear Age* (Chicago: Educational Foundation for Nuclear Science, 1986), pp. 101–106; Marek Thee, "Science-Based Military Technology as a Driving Force behind the Arms Race," in Nils Petter Gleditsch and Olav Njolstad, eds., *Arms Races: Technological and Political Dynamics* (London: Sage, 1990), pp. 105–120; Harvey Brooks, "The Military Innovation System and the Qualitative Arms Race," in Long and Rathjens, eds., *Arms, Defense Policy, and Arms Control*, pp. 75–98; Marvin L. Goldberger, "Does the Technological Imperative Still Drive the Arms Race?" in Roman Kolkowicz and Neil Joeck, eds., *Arms Control and International Security* (Boulder, Colo.: Westview, 1984), pp. 63–67; Deborah Shapley, "Technology Creep and the Arms Race," *Science* 201 (Sept. 1978), 1102–1105; Ralph Lapp, *Arms beyond Doubt* (New York: Cowles, 1970). See also widely used university textbooks such as Dietrich Schroeer, *Science, Technology, and the Arms Race* (New York: Wiley, 1984), chap. 13.

34. Rathjens, "Dynamics of the Arms Race," p. 37.

opments that are "politically and militarily irrational. . . . What seems to be technologically possible is put into practice for no better reason but because it can be done."[35] Morton Halperin claims that decisions about weapon development programs "are usually made by the military services, based on their interests *and* what is technologically possible."[36] In all these cases, nothing is said about the relative importance of strategic, bureaucratic, economic, and technological factors or the conditions under which each factor is especially important.

To date, the most sophisticated attempt to integrate these factors into a coherent explanation of weapon acquisition has been made by Matthew Evangelista. He argues that new technological discoveries trigger the weapon development process in the United States, and that scientists take the lead in suggesting military applications for these discoveries. Scientists seek support for their new ideas among their military associates and, as programs get under way, allies are sought in industry, higher levels of the executive branch, and Congress. According to Evangelista, it is only in the middle and later stages of the process that external factors, such as the identification of military threats, play a role, and they are important only in that they are needed to justify full-scale development and production. The centralized, rigid, secretive nature of the Soviet system, on the other hand, has acted to inhibit innovation. Technological initiatives have been routinely stifled and little progress made until emerging strategic threats attract the attention of high-level civilian policy makers. Defense priorities are then reassessed, resources reallocated, and crash programs devoted to developing new and important military technologies. According to Evangelista, strategic factors have thus played a central role in Soviet weapon acquisition.[37]

The main limitation of Evangelista's study is that it analyzes only innovative programs—programs that involve fundamental changes in military missions, operational doctrines, and other entrenched organizational arrangements. His generalizations may not apply to programs that fall within established mission areas, which he carefully notes. This is an important limitation, though, because as Evangelista acknowledges, mainstream programs constitute the main activity of military

35. Hans Morgenthau, "Some Political Aspects of Disarmament," in David Carlton and Carlo Schaerf, eds., *The Dynamics of the Arms Race* (London: Croom Helm, 1975), p. 62.

36. Morton Halperin, "The Limited Influence of the Military-Industrial Complex," in Morton H. Halperin, Jacob A. Stockfisch, and Murray L. Weidenbaum, *The Political Economy of the Military-Industrial Complex* (Berkeley: University of California, Institute of Business and Economic Research, 1973), p. 4, emphasis added.

37. Matthew Evangelista, *Innovation and the Arms Race* (Ithaca: Cornell University Press, 1988), pp. 22–82, 227–228, 239–240.



research and development.[38] They have certainly played a critical role in driving the Soviet–American arms race.

The main focus of this book is weapon acquisition activity that falls within established mission areas. Programs of this type have been neglected by most students of weapon acquisition and arms racing because innovative programs appear to be more important.[39] Only a few scholarly studies have focused on mainstream development efforts.[40] Although my arguments about the origins of mainstream programs are developed in more detail in later chapters, they can be sketched out here.

Major programs that fall within established mission areas are generally initiated by the military services. Military organizations are highly sensitive to threats—strategic as well as bureaucratic—to their core missions. Therefore, strategic and bureaucratic developments are generally responsible for triggering mainstream programs. The military typically sets performance requirements for new systems at the outset of its development efforts, and these requirements are frequently unattainable given available technologies. In many cases, these requirements are not met for many years, when totally unforeseen technological breakthroughs finally materialize. As a general rule, technological developments are not the driving forces behind these kinds of programs; military demands usually outpace technological supply by a wide margin. Similarly, defense contractors usually take a back seat in the early stages of these programs. They play a greater role in suggesting component and model improvements once the process is well under way. In short, strategic and bureaucratic factors are especially important in the early stages of programs that fall within established mission areas.

38. Ibid., pp. 12–13, 51, 245.

39. Studies of innovative programs include Warner R. Schilling, "The H-Bomb Decision: How to Decide without Actually Choosing," *Political Science Quarterly* 76 (March 1961), 24–46; Robert L. Perry, *System Development Strategies*, Rand Corporation Research Memorandum, RM-4853-PR, August 1966; Davis, *Politics of Innovation*; Michael H. Armacost, *The Politics of Weapons Innovation* (New York: Columbia University Press, 1969); Harvey M. Sapolsky, *The Polaris System Development* (Cambridge: Harvard University Press, 1972); Edmund Beard, *Developing the ICBM* (New York: Columbia University Press, 1976); Robert J. Art and Stephen E. Ockenden, "The Domestic Politics of Cruise Missile Development, 1970–1980," in Richard K. Betts, ed., *Cruise Missiles* (Washington: The Brookings Institution, 1981), pp. 359–413; Evangelista, *Innovation and the Arms Race*.

40. See Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston: Little, Brown, 1968); Richard G. Head, *Decision-Making on the A-7 Attack Aircraft Program* (Ph.D. Dissertation, Syracuse University, 1971); Robert F. Coulam, *Illusions of Choice: The F-111 and the Problem of Weapons Acquisition Reform* (Princeton: Princeton University Press, 1977); D. Douglas Dalgleish and Larry Schweikart, *Trident* (Carbondale, Ill.: Southern Illinois University Press, 1984); Lauren H. Holland and Robert A. Hoover, *The MX Decision* (Boulder, Colo.: Westview, 1985).

The bomber programs examined in this book are classic examples of such programs. Detailed analyses of the decision-making processes in these cases pinpoint the impact different factors had during different stages of the acquisition process. Most of these programs were begun in response to strategic developments: a change in the operational environment threatened to make existing bombers militarily ineffective. In some cases, bureaucratic motivations were also important. Many analysts have argued that military requirements are after-the-fact rationalizations for programs inspired by either technological opportunism or economic self-aggrandizement.[41] These case studies do not offer any significant support for technological or economic explanations of how weapon development programs begin.

The Army Air Corps, Army Air Force, and U.S. Air Force were flying blind in several respects when they initiated their bomber development programs. First, the nature of the operational threat they faced was not always clear because intelligence reports were frequently vague. At the same time, the technological possibilities for bomber development were not always clear, since air force organizations often failed to make a thorough assessment of the technological horizon before initiating development; thus, doctrinal and organizational preconceptions played an important role in shaping key decisions.[42] In every case examined in this book, air force decision makers compounded the unknowns their programs faced by setting performance requirements beyond, frequently far beyond, the state of the art.

## Program Outcomes

The U.S. Department of Defense has conducted some spectacularly unsuccessful weapon acquisition programs over the years. Cost, schedule, and performance problems have been the rule, not the exception. These problems are both chronic and systemic; they have deep historical roots, and they affect all military services. Two classic studies of weapon acquisition in the 1950s found substantial cost and schedule growth in most programs, with costs exceeding original estimates by an average of

41. See, for example, Brooks, "Military Innovation System," pp. 91–92; Steinbruner and Carter, "Organizational and Political Dimensions," p. 143.

42. The importance of cognitive and organizational predispositions in decision making is analyzed in James G. March and Herbert A. Simon, *Organizations* (New York: Wiley, 1958), chap. 6; John D. Steinbruner, *The Cybernetic Theory of Decision* (Princeton: Princeton University Press, 1974), chaps. 3–5; Robert Jervis, *Perception and Misperception in International Politics* (Princeton: Princeton University Press, 1976), chaps. 4–5; Posen, *Sources of Military Doctrine*, chaps. 2, 7; Jack Snyder, *The Ideology of the Offensive* (Ithaca: Cornell University Press, 1984), chaps. 1, 8; Coulam, *Illusions of Choice*, chaps. 1, 6.





300 percent and schedules slipping by an average of 50 percent. In addition, most programs failed to meet one or more of their primary performance requirements.[43] A highly regarded Rand Corporation study of acquisition outcomes in the 1960s found that the typical program had a cost overrun of about 40 percent and a schedule slippage of about 15 percent. System performance deviated from original specifications by an average of 30 to 40 percent.[44] Despite a concerted effort to reform the acquisition process in the Pentagon in the early 1970s, programs had cost overruns of 20 percent and schedule slippages of around 15 percent during that decade.[45] Serious problems continued to plague acquisition programs in the 1980s. The Sergeant York antiaircraft gun was canceled in 1985, for example, because it was tremendously expensive and technically defective.

This situation has not gone unrecognized. Indeed, the weapon acquisition process has been scrutinized by an impressive array of presidential commissions, congressional committees, and defense analysts since the 1950s.[46] Several common themes run through these studies, with a strong consensus that the acquisition process in general would work better if six steps were taken. First, acquisition regulations, procedures, and organizations should be streamlined, reducing red tape and clarifying channels of communication and areas of responsibility. Second, engineering changes and budgetary fluctuations should be

43. A. W. Marshall and W. H. Meckling, "Predictability of the Costs, Time, and Success of Development," in Richard R. Nelson, ed., *The Rate and Direction of Inventive Activity* (Princeton: Princeton University Press, 1962), pp. 461–475; Peck and Scherer, *Weapon Acquisition Process*, pp. 425–444.

44. Robert Perry et al., *System Acquisition Strategies*, Rand Corporation Report, R-733-PR/ARPA, June 1971, pp. v, 1–11.

45. Edmund Dews et al., *Acquisition Policy Effectiveness*, Rand Corporation Report, R-2516-DR&E, Oct. 1979, p. 27.

46. For the conclusions of various high-level study groups, see Commission on the Organization of the Executive Branch of the Government (the Hoover commission), *Report on Military Procurement*, June 1955; Blue Ribbon Defense Panel (the Fitzhugh commission), *Report to the President and the Secretary of Defense on the Department of Defense*, July 1970; Commission on the Organization of Government for the Conduct of Foreign Policy (the Murphy commission), *Report*, Vol. 4, pt. II, June 1975; Blue Ribbon Commission on Defense Management (the Packard commission), *A Quest for Excellence*, June 1986; Secretary of Defense Richard Cheney, *Defense Management*, July 1989. In addition, see congressional reports such as *Weapons Acquisition Policy and Procedures*, Report of the Special Panel on Defense Procurement Procedures, House Armed Services Committee, 97th Cong., 1st sess., Dec. 1981; *Defense Organization*, Staff Report, Senate Armed Services Committee, 99th Cong., 1st sess., Oct. 1985. Studies by independent defense analysts and scholars include *U.S. Defense Acquisition* (Washington: Center for Strategic and International Studies, March 1987); J. Ronald Fox, *The Defense Management Challenge* (Boston: Harvard Business School Press, 1988); Gansler, *Affording Defense*; Thomas L. McNaugher, *New Weapons, Old Politics* (Washington: The Brookings Institution, 1989); Alan R. Yuspeh, "The Acquisition Process," in James A. Blackwell, Jr., and Barry M. Blechman, eds., *Making Defense Reform Work* (Washington: Brassey's, 1990), pp. 215–236.

minimized, promoting program stability. Third, independent cost estimates should be used more widely to prevent contractors and the services from misrepresenting program costs. Fourth, independent tests of new weapons should be conducted on a more regular basis, providing decision makers with better information about technical progress and operational effectiveness. Fifth, program management should be improved; this could be accomplished by providing acquisition personnel with better training, better pay, more opportunities for advancement, and longer program assignments. Sixth, criminal activity—including fraud, overbilling, and misuse of insider information—should be investigated and prosecuted aggressively.

Although defense analysts agree about these general issues, they disagree about why some programs turn out worse than others. One school of thought holds that programs with ambitious development objectives are especially prone to cost, schedule, and performance problems. Another maintains that troubles arise when development and production activities take place at the same time, that is, when concurrent procurement strategies are adopted.

### *Development Objectives*

Defense analysts have long suspected that technologically adventurous programs encounter more than their share of acquisition problems.[47] As Congressman William Dickinson has argued, "for every ten acquisition programs that have problems, perhaps nine are caused by overly-ambitious 'requirements' that push the technology too hard."[48]

Several members of the military reform movement—a loose, bipartisan coalition of defense analysts, former military officers, journalists, congressional staffers, and several dozen members of both houses of Congress—have seized on this issue. According to James Fallows, "the distinguishing feature of modern American defense has been the pursuit of the magic weapon." This "wonder-weapon mentality," as he puts it, is based on the misguided belief that the pursuit of high technology leads to high-quality weapons and a sound defense.[49] In fact, he and others argue, technologically ambitious and complex weapons generate a wide variety of developmental and operational problems.

One problem is the high unit costs of such weapons; the military can afford to buy relatively few of each. There are obvious operational problems associated with shrinking force structures. Congressman Newt

47. See, for example, Marshall and Meckling, "Predictability of the Costs," p. 475.
48. From "Text of Dickinson Letter to Boxer on Concurrency," *Aerospace Daily*, June 11, 1987, p. 408.
49. James Fallows, *National Defense* (New York: Random House, 1981), pp. 35, 60–61.





Gingrich summed up the thinking of many military reformers on this point when he said, "high technology limits size and, as Lord Nelson warned us, numbers annihilate."[50] In addition, complex weapons are said to be less reliable than their simpler counterparts. Even if they are ready for action, complex weapons are difficult to operate, and considerable training is required before they can be used proficiently. They are also more expensive to operate and maintain than simpler weapons. Finally, it is said that technologically ambitious weapons slow down force structure modernization because they take longer to build than simpler weapons.[51]

What is needed, Fallows suggests, is the development of "simple, reliable, flexible tools that can be produced quickly."[52] In other words, national security would be better served by weapon acquisition programs that, on the whole, featured more modest development objectives.

### *Procurement Strategies*

Given a set of development objectives, one of two basic procurement strategies can be employed: sequential or concurrent.

Sequential strategies are based on the assumption that research and development programs are laced with technological uncertainties that are best resolved by proceeding in an orderly, sequential manner. The traditional stages of the acquisition process—research, design development, engineering or full-scale development, production, and deployment—are not compressed, nor are they allowed to overlap. A conscious effort is made to develop systems fully and test them thoroughly before making a decision to proceed with production. Simple prototypes are built and tested during the development phase of the process and, if possible, competing prototypes are tested against one another. Final designs and program schedules are kept flexible while developmental testing takes place. These tests help to identify residual development problems, and they provide decision makers with solid sets of facts on which to base their design, source selection, and production decisions. Funding is kept to a minimum during the development phase of sequen-

50. Gingrich, *Congressional Record* 127 (Sept. 11, 1981), H6149. For a more scholarly analysis of this issue, see Michael Handel, "Numbers Do Count: The Question of Quality versus Quantity," *Journal of Strategic Studies* 4 (Sept. 1981), 225–260.
51. See Fallows, *National Defense*, pp. 35–75; Franklin C. Spinney, *Defense Facts of Life* (Boulder, Colo.: Westview, 1985), pp. 5–111. For a pointed critique of these arguments, see William Perry, "Fallows' Fallacies," *International Security* 6 (Spring 1982), 174–182. For a review of the military reform debate as a whole, see Asa A. Clark et al., eds., *The Defense Reform Debate* (Baltimore: Johns Hopkins University Press, 1984).
52. Fallows, *National Defense*, p. 29.

tial programs in order to keep sunk costs and procurement momentum under control. As a result, a bold line is drawn between development and production, and a discrete production decision follows the conclusion of the development phase of the process.[53]

Concurrent strategies try to speed up the acquisition process by initiating production activities while development is still under way. Such strategies are based on the assumption that acquisition programs are fundamentally predictable and that residual technological uncertainties can be resolved without relying on prototype testing in the development phase of the process. Instead, paper studies are used to map out and confirm the designs of entire systems, including all attendant subsystems. Once these studies are completed, designs are frozen and highly compressed development and production schedules are drawn up. Production materials and hard production tooling are purchased during the development phase, and the first production units are relied on for hardware testing. In concurrent programs, therefore, hardware testing cannot begin until production lines are up and running. Since it is expensive to support two contractors under these conditions—two production lines would have to be set up—competition in concurrent programs usually ends prior to full-scale development. Even so, concurrent programs involve substantial financial commitments early in the development process because of the expenses associated with moving into production. In short, de facto and sometimes explicit production decisions are made during the development phase of concurrent programs.[54]

Concurrent strategies have dominated U.S. weapon acquisition throughout most of the postwar period. This has led many to conclude that concurrency should be deemphasized, if not eschewed altogether, and that sequential strategies should be strongly favored. A long series of Rand Corporation studies dating back to the late 1950s has taken this position.[55] In 1970, the president's Blue Ribbon Defense Panel recom-

53. See B. H. Klein, T. K. Glennan, Jr., and G. H. Shubert, *The Role of Prototypes in Development*, Rand Corporation Research Memorandum, RM-3467/1-PR, April 1971; Robert Perry, *A Prototype Strategy for Aircraft Development*, Rand Corporation Research Memorandum, RM-5597-1-PR, July 1972; G. K. Smith et al., *The Use of Prototypes in Weapon System Development*, Rand Corporation Report, R-2345-AF, March 1981; Perry, *System Acquisition Strategies*.

54. See the sources cited in note 53. See also Perry, *System Development Strategies*, pp. 101–111; U.S. Congressional Budget Office (CBO), *Concurrent Weapons Development and Production*, Aug. 1988.

55. See, for example, B. H. Klein, W. H. Meckling, and E. G. Mesthene, *Military Research and Development Policies*, Rand Corporation Report, R-333, Dec. 1958; Klein, *Role of Prototypes; Perry, System Acquisition Strategies;* Perry, *Prototype Strategy;* Smith, *Use of Prototypes;* Michael Rich and Edmund Dews, *Improving the Military Acquisition Process*, Rand Corporation Report, R-3373-AF/RC, Feb. 1986.





mended implementing "a general rule against concurrent development and production."[56] In the early 1970s, Deputy Secretary of Defense David Packard instituted a "fly before you buy" strategy that was successfully applied to some programs.[57] Packard's reforms withered after he left the Pentagon, though, and the 1986 Blue Ribbon Commission on Defense Management, which he headed, was forced to sing a familiar refrain: the Department of Defense should "require the testing of prototype systems and subsystems before the authorization of full-scale development."[58] When asked about concurrency in 1987, Les Aspin, chairman of the House Armed Services Committee, said, "I think it's always a mistake."[59]

### *Analyzing the Outcomes of Weapon Acquisition Programs*

I argue that it is simplistic to focus on either development objectives or procurement strategies in analyzing acquisition outcomes; the success of a weapon acquisition program is a function of the interaction between its development objectives and the procurement strategy on which it is based. Certain combinations of objectives and strategies are likely to be successful. Others are likely to generate disastrous cost, schedule, and performance outcomes.

For the moment, it might be useful to think of a program's development objectives as being either modest or ambitious, although in the real world they might be found anywhere along a continuum. A program with modest objectives relies heavily on off-the-shelf components and proven technologies. It seeks few technological advances. On the other hand, a program with ambitious objectives seeks major advances in the state of the art. Similarly, it might be useful to think of procurement strategies as being either sequential or concurrent, although many programs contain elements of both. These simple distinctions lead us to the matrix depicted in Figure 1.

Sequential strategies are particularly appropriate, even essential, for programs with ambitious development objectives (combination *A* in Fig-

56. Blue Ribbon Defense Panel, *Report to the President*, p. 8.

57. Packard's approach was based on the analytic work done at Rand and the recommendations of the Blue Ribbon Defense Panel. For expositions of Packard's views, see his testimony in *Policy Changes in Weapon System Procurement*, Hearings before the House Government Operations Committee, 91st Cong., 2d sess., Sept. 1970, pp. 1–42, 287–324; *Advanced Prototype*, Hearings before the Senate Armed Services Committee, 92d Cong., 1st sess., Sept. 1971, pp. 1–57. The application of Packard's strategy to several aircraft programs is analyzed in Smith, *Use of Prototypes*.

58. Blue Ribbon Commission on Defense Management, *A Formula for Action*, April 1986, p. 32.

59. Aspin quoted in John H. Cushman, Jr., "Build-Now-Finish-Plan-Later Plan," *New York Times*, March 4, 1987.

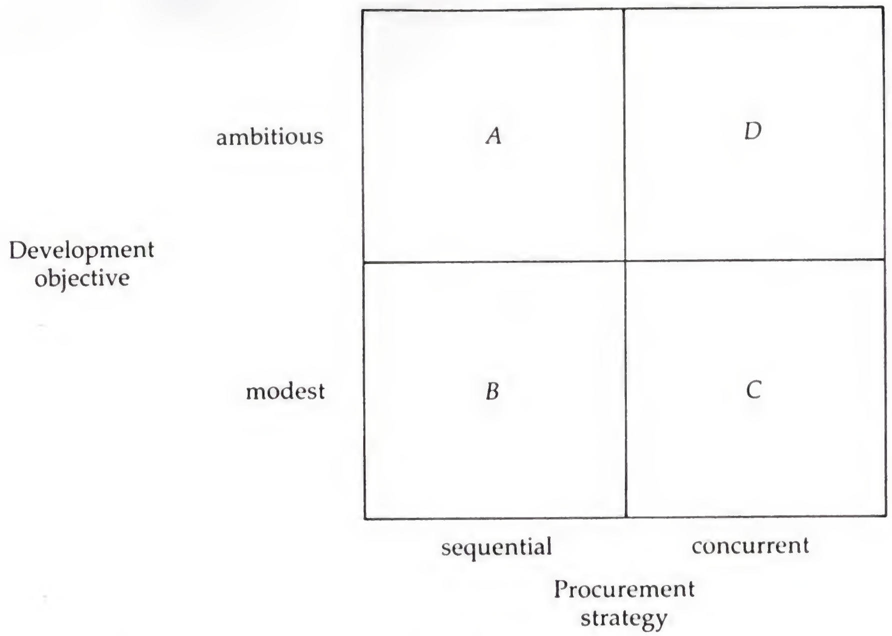



*Figure 1.* Development objectives and procurement strategies

ure 1). Programs that rely on major technological advances need extensive prototype testing to ensure that all major technological questions are resolved before system designs are frozen and production decisions made. It is important to resolve major technological uncertainties before making commitments to production, and these uncertainties are especially formidable in ambitious programs. Sequential strategies provide the best way of reducing developmental uncertainties. In addition, programs that are committed to major technological advances might run into snags. Sequential programs are inherently resilient because system designs and acquisition schedules are not firm, and competitive programs provide fallback options in the event that some development efforts fail. Finally, sequential strategies keep sunk costs to a minimum until explicit production decisions are made. This is important because some technologically ambitious programs fail and therefore need to be canceled.

Sequential strategies may not be necessary, however, when development objectives are relatively modest (combination *B*). Extensive hardware testing may not be needed when most of a system's technologies are within the state of the art. Testing already proven hardware is wasteful and time-consuming.



Given modest development objectives, concurrent strategies may be optimal (combination *C*). Programs that do not involve major technological advances may not need extensive prototype testing. The final designs of these kinds of systems may indeed be fairly predictable, so it is not unreasonable to begin buying production materials and tooling during the development phase of the acquisition cycle. For programs with modest objectives, concurrent strategies may deliver operational systems quickly and inexpensively.

Concurrent strategies are particularly inappropriate, however, for programs with ambitious development objectives (combination *D*). Programs with new and exotic technologies probably need extensive testing before system designs can be frozen. More important, it is risky to make production commitments to these kinds of programs early in the development process. Under concurrency, however, one has to begin buying production tooling and materials before prototype testing can take place. As a result, considerable investments have to be made in highly speculative ventures. This combination of objectives and strategies is consequently very risky.

Contrary to what some in the military reform movement have argued, it *is* possible to build technologically ambitious weapons without incurring cost overruns, schedule slippages, and performance shortfalls. "High technology" programs are not doomed to fail. The key is to employ sequential strategies in these cases. It is also important to note that, contrary to what many analysts have argued, sequential and concurrent strategies are, by themselves, neither good nor bad. Each strategy is optimal some of the time; neither is optimal all of the time.

If we think of development objectives and strategies as falling along two continua, our simple matrix can be replaced by Figure 2. Programs with appropriate combinations of objectives and strategies are likely to have optimal outcomes. Other combinations tend to produce less satisfactory outcomes: some are wasteful, others are risky.

A more elaborate set of definitions is needed to make this framework useful. The nine levels of technological ambitiousness defined in Table 1 enable us to categorize development objectives with some precision.[60] To categorize procurement strategies we can use the eight criteria outlined in Table 2: highly sequential programs exhibit none of the earmarks of concurrency; highly concurrent programs exhibit all eight.[61] Given these two sets of variables, we can categorize programs according to the

60. For more discussion of the methodological issues associated with this kind of categorization, see S. James Press and Alvin J. Harman, *Methodology for Subjective Assessment of Technological Advancement*, Rand Corporation Report, R-1375, April 1975.

61. The eight criteria for categorizing procurement strategies are not rank-ordered. All are considered to be equally important.

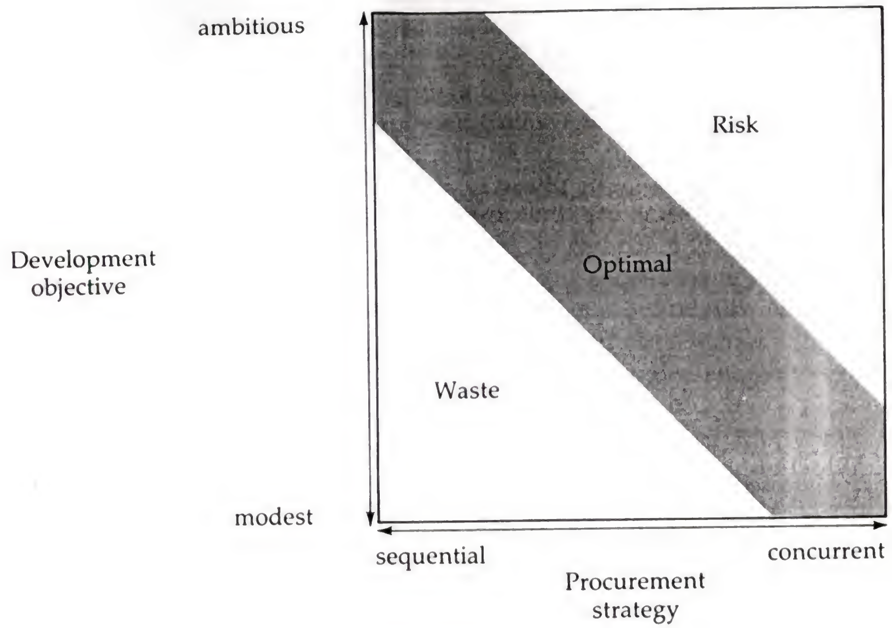



*Figure 2.* Development objectives, procurement strategies, and program outcomes

9 × 9 matrix depicted in Figure 3 and, from that, make some predictions about program outcomes.

For example, Program *X* (Figure 3) involves some technological advances and is based on a procurement strategy that contains both sequential and concurrent elements. Its procurement strategy is well suited to its level of technological risk, so it will probably be relatively successful in meeting its cost, schedule, and performance targets. On the other hand, Program *Y* is technologically ambitious and it features a

*Table 1.* Levels of technological ambitiousness

1. New and radically different system design is needed.
2. New technology must be developed to meet system needs.
3. New technology must be developed to meet subsystem needs.
4. Several major subsystems require major improvement.
5. One major subsystem requires major improvement.
6. Several subsystems require some improvement.
7. One subsystem requires some improvement.
8. Contemporary technologies must be integrated into the program.
9. No new technology or hardware is needed; off-the-shelf components can be utilized.

*Source*: Adapted from Robert Perry et al., *Systems Acquisition Strategies*, Rand Corporation Report, R-733-PR/ARPA, June 1971, pp. 10–14.



*Table 2.* Criteria for categorizing procurement strategies

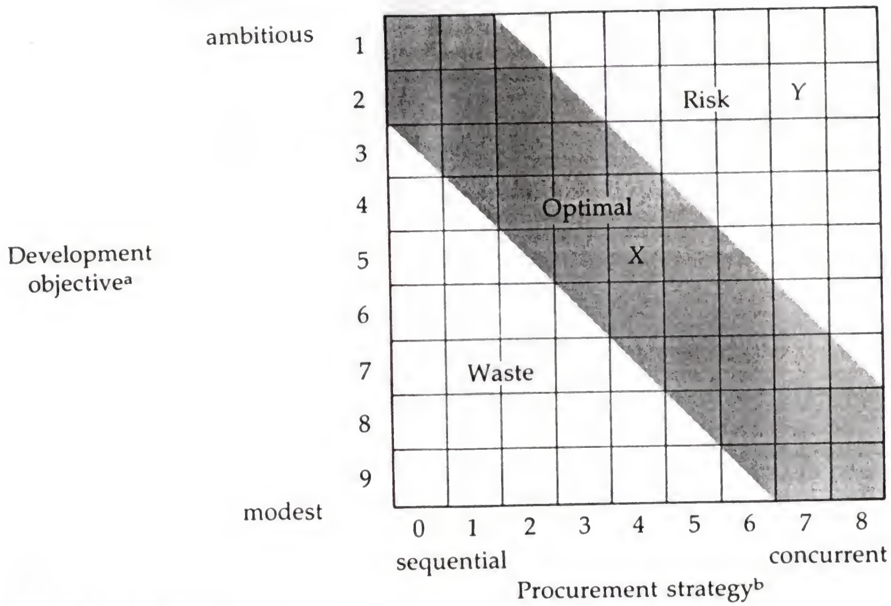
| Element | Sequential strategy | Concurrent strategy |
|---|---|---|
| System design | Flexible during development phase | Frozen as soon as possible |
| Military subsystems | Not initially integrated into system design | Fully integrated into design from beginning |
| Source of critical program information | Prototype testing | Paper studies |
| Initial tooling (first prototype) | Soft development tooling (development prototype) | Hard production tooling (production prototype) |
| Development and production schedules | Open-ended and flexible | Preplanned and rigid |
| Competition | Preserved through full-scale development | Ended at design phase |
| Funding during development phase | Minimal | Substantial |
| Production decision | Discrete decision follows full-scale development | De facto decision made during development |

highly concurrent procurement strategy. This program will probably encounter serious problems.

Program success and failure also need to be defined more precisely. My focus is on the success of programs as acquisition programs, and so I compare the actual cost, schedule, and performance of the systems in question to their original targets.[62] It is also important to consider how effective programs were in resolving the technological uncertainties originally associated with them. Therefore, I also consider the amount of retrofitting associated with each program—that is, the extent to which critical subsystems had to be installed after the main system left the factory and the extent to which extensive modifications had to be made to bring the weapon up to its design specifications.

The set of cases I examine in this book is well suited to a study of acquisition outcomes; it contains significant variation across all relevant variables. Some of these programs were extremely ambitious technologically (e.g., B-35, B-47, B-58, B-70, B-2), while others were only moderately ambitious (B-36, B-52, B-1, B-1B). Some used highly concurrent procurement strategies (B-58, B-70, B-1B, B-2), while two featured highly sequential strategies, at least in their early stages (B-47, B-52).

62. This approach has been used in many Rand Corporation studies over the years, including Perry, *System Acquisition Experience;* Dews, *Acquisition Policy Effectiveness.* For a more detailed discussion of how such assessments can be made, see Alvin J. Harman and Susan Henrichsen, *A Methodology for Cost Factor Comparison and Prediction,* Rand Corporation Research Memorandum, RM-6269-ARPA, Aug. 1970.; G. K. Smith and E. T. Friedmann, *An Analysis of Weapon System Acquisition Intervals, Past and Present,* Rand Corporation Report, R-2605-DR&E/AF, Nov. 1980.




[a]As defined in Table 1.
[b]Categorized according to the number of concurrent elements exhibited, as defined in Table 2.

*Figure 3.* Development objectives, procurement strategies, and program outcomes: a framework for analysis

Finally, some programs were quite successful in meeting their cost, schedule, and performance targets, while others were unmitigated disasters. The use of case studies enables us to see how development objectives and procurement strategies interacted to bring these outcomes about. One could not develop this insight through a simple statistical analysis of a set of programs.

A close examination of detailed case studies also allows us to address a critical question: what led to the adoption of these development objectives and procurement strategies? One of my main arguments is that a powerful set of strategic and bureaucratic forces pushed these programs in the direction of extremely ambitious development objectives and highly concurrent procurement strategies simultaneously. As a result, many of these efforts had serious problems. This pattern is widespread in the United States, and it has proved resistant to repeated reform efforts, suggesting that the forces that shape acquisition programs are powerful indeed. Although I develop these arguments in detail in later chapters, I can outline them here.

Many U.S. Air Force leaders believed that technology was decisive in warfare and that it was consequently important to push the state of the



art in weapon development programs. Many also believed that technological innovation was the United States' area of comparative advantage in the strategic competition with the Soviet Union. In addition, it was widely held that defense planners should make pessimistic assumptions about future operational threats when they established performance requirements for new weapons. These strategic considerations were strongly reinforced by the Air Force's bombardment doctrine, which placed enormous emphasis on highly capable aircraft. Air Force thinking dictated that its bombers have exceptional range, speed, altitude, payload, and defensive armament capabilities. Air Force decision makers were able to push several performance parameters at once and ignore the trade-offs inherent in their requirements by assuming that technological advances would eventually save the day. They were encouraged in this by the technical commands in the Air Force and by the various aerospace companies involved in these projects, none of which had a vested interest in discouraging new programs, and all of which were infected with a "can do" attitude toward technological challenges such as these. Finally, the Air Force needed to sell its new programs to the civilian leadership in the executive branch and Congress. Thus, its new programs had to promise a substantial improvement in capabilities over existing systems. In short, mutually reinforcing strategic and bureaucratic forces pushed Air Force performance requirements beyond the state of the art, and the Air Force's bomber programs frequently had extremely ambitious development objectives.

At the same time, there seemed to be a compelling need to get new bombers into the force structure as soon as possible. This sense of urgency, justified or not, loomed over American weapon acquisition efforts for most of the postwar period. As a result, there seemed to be a legitimate strategic reason for adopting concurrent procurement strategies, which held out the promise of deploying weapons quickly. The Air Force also preferred concurrency for internal reasons. First and foremost, concurrent programs were difficult to cancel because they moved into production quickly and because a great deal of money was spent on them early in the acquisition process. Concurrent programs were also easier to sell to the civilian leadership in the defense establishment because they appeared to be cheaper than their sequential counterparts. Finally, concurrency enabled the Air Force to sidestep a painful trade-off: its technologically ambitious bombers would take a long time to develop and build unless something was done to compress the acquisition cycle.

Why did the civilian leadership allow the Air Force to pursue these policy preferences? For one thing, civilians rarely became involved in the requirements formation process because it was part of the military's professional domain. In any event, many civilians also believed that it

was important to push technology for reasons of national security. As far as procurement strategies were concerned, many civilians joined military leaders in believing that it was important to deploy new strategic systems without delay. Others, such as Secretary of Defense Robert McNamara, believed that paper studies could substitute for prototype testing. It is not surprising that concurrency flourished in the Pentagon under McNamara's stewardship in the 1960s.

There have, however, been three discrete periods since 1945 when some programs have been guided by sequential strategies: in the late 1940s, when budgetary constraints prevented the services from pushing their programs into production; in the early 1970s, when Deputy Secretary of Defense Packard championed the cause of prototyping and austere, sequential development; and in the late 1980s, when some programs were reoriented in the wake of the Packard commission's strong endorsement of sequential strategies.[63] In each case, there were special circumstances surrounding the employment of sequential procurement strategies. In the first case, severe budgetary constraints impinged on the acquisition process, and, in the last two cases, direct, high-level civilian intervention accounted for whatever policy shifts took place. Concurrency has been the dominant strategy during the rest of the postwar period. One of the main arguments of this book is that military organizations prefer concurrent procurement strategies for a variety of strategic and bureaucratic reasons. Moreover, military organizations generally—but not always—are left to themselves to pursue these preferences.[64]

The Air Force was flying blind when it repeatedly issued performance requirements that demanded major technological advances. The feasibility of these requirements was not adequately assessed in most cases. Totally unforeseen technological breakthroughs had to take place before the requirements could be met. The Air Force was not being bold and farsighted when it set these extraordinarily ambitious development objectives; its disregard of technological uncertainties was reckless. The Air Force was also flying blind when it imposed concurrency on its development and production programs. Concurrency's arbitrary assumptions about technological feasibility were not examined closely

63. For more discussion on the use of sequential strategies in earlier eras, see Smith, *Use of Prototypes*, pp. 1–4. The Air Force's Advanced Tactical Fighter program and the Navy's Advanced Tactical Aircraft program were restructured to include more competitive prototyping after the Packard commission's recommendations came out in 1986; see James Kitfield, "ATF: Playing by New Rules," *Military Logistics Forum*, Sept. 1986, pp. 13–18. I discuss this in more detail in Chapter 9.

64. Posen analyzes organizational preferences toward certain kinds of operational doctrines as well as the conditions under which civilian intervention is likely to intrude on these policy preferences; see *Sources of Military Doctrine*, chaps. 2 and 7.



when it was applied to technologically ambitious development programs. The lack of developmental testing and the compressed development and production schedules that were part and parcel of concurrency only compounded the risks that these programs faced. It is not surprising, then, that concurrency proved to be badly counterproductive in these cases.

Chapter 2 provides general background on the evolution of American air forces in the first half of this century, in particular, the development of strategic bombardment doctrine and strategic bomber forces in the years leading up to World War II. The fifteen programs examined in this book are organized into six case studies (Chapters 3–8). Snapshots of these programs are provided in Table 3 and Figure 4. Chapter 3 focuses on the medium-range jet bomber competition of the late 1940s, which included the B-45, B-46, B-47, and B-48. The B-47 won this competition and was produced in great numbers in the 1950s. Chapter 4 is an analysis of the B-35, B-36, B-49, B-52, and B-60 programs, the long-range bomber programs of the 1940s and early 1950s. Chapter 5 covers the

*Table 3.* U.S. strategic bomber acquisition programs since 1941

| Program | Began[a] | Ended[b] | Number built | Contractor |
|---|---|---|---|---|
| B-35 | 1941 | 1944 | 15[c] | Northrop |
| B-36 | 1941 | 1954 | 366 | Convair |
| B-45 | 1944 | 1948[d] | 142 | North American |
| B-46 | 1944 | 1948 | 1 | Convair |
| B-47 | 1944 | 1957 | 1,923 | Boeing |
| B-48 | 1944 | 1948 | 2 | Martin |
| B-49 | 1945 | 1949 | 3 | Northrop |
| B-52 | 1946 | 1962 | 744 | Boeing |
| B-58 | 1951 | 1962 | 116 | Convair[e] |
| B-60 | 1950 | 1952 | 2 | Convair |
| ANP[f] | 1951 | 1956 | 0 | several |
| B-70 | 1955 | 1962 | 2 | North American |
| B-1A | 1970 | 1977 | 4 | North American Rockwell[g] |
| B-1B | 1981 | 1988 | 100 | Rockwell |
| B-2 | 1981 | — | 75[h] | Northrop |

[a]Date of first major development contract.
[b]Date of production cancellation or end of production run.
[c]Three were converted into B-49s.
[d]The decision to halt the B-45 production run was made in 1948, although production actually continued into the 1950s.
[e]Convair became the Fort Worth Division of General Dynamics in 1961.
[f]Aircraft Nuclear Propulsion (nuclear-powered bomber) program.
[g]North American Aviation merged with the Rockwell Standard Corporation in 1967. The new company was known as North American Rockwell until 1973, when its name was changed to Rockwell International.
[h]Planned production run.

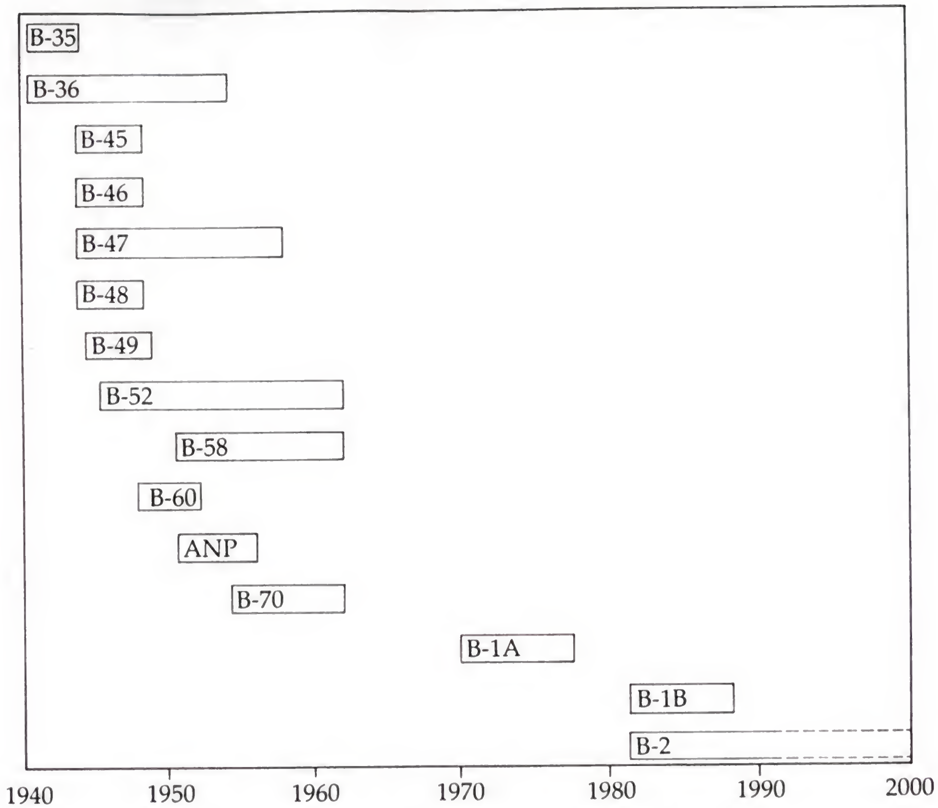



*Figure 4.* U.S. strategic bomber acquisition programs since 1941

origins and evolution of the B-58, the supersonic successor to the B-47. Chapter 6 examines the nuclear-powered bomber program, also known as the aircraft nuclear propulsion (ANP) program, as well as the B-70. Both were to be long-range bombers, but the ANP program was canceled in the mid-1950s and the B-70 was canceled in the early 1960s. Chapter 7 is an analysis of the B-1 bomber, now known as the B-1A, from its conception in 1961 until its cancellation in 1977 by President Carter. Chapter 8 presents a look at the B-1B, a modified version of the B-1 resurrected by the Reagan administration in 1981, and the B-2, which moved quickly from development to production in the 1980s. I conclude in Chapter 9 with some general observations about the origins and outcomes of weapon acquisition programs and the implications of this study for weapon acquisition reform. An appendix provides a brief overview of the evolution of U.S. Air Force weapon acquisition organizations since the early 1940s.



# [2]

# *Historical, Organizational, and Doctrinal Setting*

People thought about dropping bombs from the sky long before there were airplanes. In 1670, the Italian Jesuit Francesco Lana speculated that airships might one day be able to bomb targets with impunity, destroying buildings and capsizing ships in the process. He raised this possibility over one hundred years before the first manned balloon flight, which took place in 1783 outside Versailles. Austria was the first country to use hot-air balloons as bombing platforms; the results of its attack on Venice in 1849 were uneven at best. To each of approximately two hundred unmanned balloons Austrian soldiers attached one time-fused bomb. Many of the balloon bombs went astray, some blew back over the Austrian lines, and those that reached the target did little damage. Balloons were used fairly extensively in the early years of the American Civil War, mainly for scouting enemy troop movements, but they were almost completely neglected by the U.S. military for the remainder of the century. The situation was quite different in Europe at this time, where competitive pressures were substantially keener. Each of the great powers in Europe established a balloon corps and was actively engaged in balloon research in the latter third of the nineteenth century. Germany and France, most notably, were starting to build steerable, rigid airships, or dirigibles, as the century came to a close.[1] There was already a great deal of interest in military aviation in some quarters,

1. For this summary and more discussion on developments prior to 1900, see Basil Collier, *A History of Air Power* (New York: Macmillan, 1974), pp. 1–42; Charles DeForest Chandler and Frank D. Lahm, *How Our Army Grew Wings* (New York: Ronald, 1943), chaps. 1–8.

therefore, when Orville and Wilbur Wright made the first powered flight in a heavier-than-air craft near Kitty Hawk, North Carolina, on December 17, 1903.

## Early Years

The U.S. Army, consistent if nothing else, showed little early interest in airplanes, even though the Wright brothers made over one hundred successful flights in 1904 and approached the Army for funding on three separate occasions in 1905. The only step the Army took to get involved in aviation was to create the Aeronautical Division in the Signal Corps in August 1907. Although the new division's charter was "to study the flying machine and the possibility of adapting it to military purposes," it was not given any money to fund experimental studies.[2] Moreover, the new Aeronautical Division had a staff of only three, one officer and two enlisted men, one of whom deserted shortly after receiving his new assignment. Funding for airplane projects was not forthcoming until the Aero Club of America brought the Army's apathy to the attention of President Theodore Roosevelt, who personally intervened in the case and directed the Army to begin investigating aeronautical activities more vigorously. This led the Army to issue a request for aircraft proposals in December 1907, which in turn led to a $25,000 contract with the Wright brothers in February 1908.[3]

Even so, technical progress continued to be slow because, year after year, Congress refused to set aside funds specifically for aeronautical development. There seemed to be no compelling strategic rationale for a major research and development program in this area, since the Atlantic and Pacific oceans protected the continental United States from European and Asian air forces, and Congress had no intention of getting involved in a war in Europe, should one break out. Army aviation programs consequently had to be financed out of the department-wide experimental fund, where they had to compete with more conventional programs put forward by powerful bureaucratic sponsors. Only in 1911 did Congress, under growing public pressure, appropriate $125,000 for Army aviation. This enabled the Aeronautical Division to

2. Quoted in George E. Stratemeyer, "Administrative History of the U.S. Army Air Forces," *Air Affairs* 1 (Summer 1947), 510.

3. The most detailed account of this episode is in Chandler and Lahm, *How Our Army Grew Wings*, chap. 10.



establish a flying school and gradually increase its number of certified pilots.[4]

Over the next few years, Army aviators conducted experiments to develop the military value of the airplane. Many of these experiments, such as testing bombsights and bomb-dropping devices, were designed to enhance the airplane's potential as a bombing platform. From the beginning, Army aviators saw the airplane "not only as a means of observation and liaison, but as a striking arm against forces in the field and supporting facilities to the rear."[5]

The meager appropriations set aside for military aviation nonetheless left the United States far behind every major European power, all of which made a concerted effort to develop aviation forces. France, for example, spent $7.4 million on aviation in 1913 alone; Germany and Russia spent $5 million each. The United States, on the other hand, set aside only $125,000 for aviation in 1913, less than one-third of what Mexico devoted to the same activity. Inevitably, American air forces were smaller and less advanced than those of nearly every other great power. France, for example, fielded 260 military aircraft on the eve of the Great War, whereas the United States had only six serviceable aircraft in its inventory at the time.[6]

Some in Congress felt that new organizational arrangements were needed to facilitate the development of American air forces. Two bills were proposed in 1913, both of which would have taken aviation activities away from the Signal Corps but still left them under the supervision of the Army. The secretary of war opposed these bills on the grounds that "the aviation service . . . is nothing but another branch of the service of information, which includes all communication, observation, and reconnaissance."[7] Clearly, the Army establishment had an extremely narrow view of how air forces should be used. Many pilots also opposed these bills, but on the grounds that aviation was not yet developed enough to become a separate service. Younger pilots, however, were more inclined to create a separate service on the spot and

4. See ibid. Also, Arthur Sweetser, *The American Air Service* (New York: Appleton, 1919), pp. 10–12; Irving B. Holley, Jr., *Ideas and Weapons* (New Haven: Yale University Press, 1953), pp. 27–28; Alfred Goldberg, ed., *A History of the United States Air Force, 1907–1957* (Princeton: Van Nostrand, 1957), pp. 3–6.

5. Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917–1941*, Air University, Dec. 1957, p. 3.

6. See Sweetser, *American Air Service*, p. 16; Holley, *Ideas and Weapons*, p. 29.

7. Quoted in Stratemeyer, "Administrative History," p. 511. The War Department became the Department of the Army when the U.S. military establishment was reorganized in 1947.

thus escape superiors who knew "little or nothing" about flying.[8] In the end, both bills were defeated.

It was, however, widely recognized that military aviation had to be given a more permanent footing and a higher profile. As it stood, the Aeronautical Division was simply the product of an administrative order; theoretically, it could be dissolved whenever the Army chose to do so. The Army certainly had the authority to change manpower levels at will. This, along with the division's lowly organizational status and the lack of proper compensation for extremely hazardous duty, made recruitment difficult and morale poor. With this in mind, Congress decided to give Army aviation a statutory basis. It authorized personnel slots for 60 officers and 260 enlisted men, and it raised pay levels for aviators. Legislation creating the Aviation Section of the Signal Corps was enacted on July 18, 1914, ten days before Austria declared war on Serbia.[9]

## American Air Forces in World War I

The United States did little to build its military aviation forces as the war in Europe unfolded. Budgets remained low, and acquisition plans remained modest. The only significant American step during the early months of the war was the creation in March 1915 of the National Advisory Committee for Aeronautics (NACA) to sponsor and coordinate scientific research on the problems of flight. NACA was given an annual budget of only $5,000.[10]

8. See Goldberg, *History of the United States Air Force*, p. 8; Stratemeyer, "Administrative History," p. 512; Chase C. Mooney and Martha E. Layman, *Organization of Military Aeronautics, 1907–1935*, Historical Study No. 25, Historical Division, Asst. Chief of Air Staff for Intelligence, Dec. 1944, pp. 10–17; R. Earl McClendon, *The Question of Autonomy for the United States Air Arm, 1907–1945*, Air University Documentary Research Study, Nov. 1950, pp. 27–42.

9. See Stratemeyer, "Administrative History," pp. 511–512; Goldberg, *History of the United States Air Force*, p. 8; Sweetser, *American Air Service*, pp. 20–21.

10. In addition, American aviators were very much in the dark about how the air war in Europe was progressing. The warring powers were all highly secretive about the performance capabilities of their aircraft and their operational experiences. When asked by the House Military Affairs Committee if the Army's Aviation Section was keeping up on developments in the war, one colonel replied, "I think we are, as far as it is possible to say that we are keeping abreast of conditions that we do not know anything about"; quoted in Sweetser, *American Air Service*, p. 26. Discussion of the 1915–18 period is based on ibid., chaps. 2, 12; Holley, *Ideas and Weapons*, chaps. 2–4, 7–8; Goldberg, *History of the United States Air Force*, chap. 2; James L. Cate, "The Air Service in World War I," in Wesley F. Craven and James L. Cate, eds., *The Army Air Forces in World War II*, 7 vols. (Chicago: University of Chicago Press, 1948), vol. 1, pp. 3–16; Historical Section, Army War College, *The Signal Corps and Air Service* (Washington: Government Printing Office, 1922), pt. 2; Mooney and Layman, *Organization of Military Aeronautics*, pp. 26–36.



As the international situation deteriorated, policy makers in Washington became increasingly concerned about the level of military preparedness in the United States. An emergency appropriation of $500,000 for military aviation was approved in March 1916, followed by a $13.3 million appropriation in August. Germany began unrestricted submarine warfare in February 1917, which led to American entry into the war in April. At the time, there were only two hundred aircraft in the Army's inventory. Most of these were trainers, and all were technologically obsolete.

Many Americans entered the war with naive expectations about the impact U.S. air forces would have on the course of the conflict. Many believed that, once the country's industrial capacities were engaged, "clouds" of American airplanes would break the gruesome stalemate on the European battlefield and bring the war to a quick conclusion. After some debate, it was announced that the United States planned to build 22,625 airplanes in the first six months of 1918. This was ambitious, to say the least, given that the American aircraft industry had produced fewer than one thousand airplanes, civilian and military, between 1903 and 1916. Congress nonetheless put this plan in motion in August 1917 with an appropriation of $640 million, the largest made to that time for a single purpose.

This plan was doomed to fail. New aircraft designs were needed in order to catch up with the many technical advances that had been made in Europe since 1914. Developing new designs would take months, at a minimum. European designs could be used, but even then it would take time before dozens of production lines could be set up. In any event, the Aviation Section was not experienced enough to supervise a program of this magnitude. In short, there was no way to overcome a decade of neglect in less than one year. When it became clear in early 1918 that production output would fall far short of expectations, widespread disillusionment set in and, inevitably, various investigations into the matter were launched.[11]

This state of affairs led President Woodrow Wilson to reorganize the Army's aviation activities in May 1918. Aviation was taken away from the Signal Corps and placed under the general jurisdiction of the War Department. The Bureau of Aircraft Production was given responsibility for acquisition activities, and the Division of Military Aeronautics was placed in charge of operational matters. These two offices would be overseen by the director of the Air Service, who would also be the

11. Only 11,000 aircraft were built in the United States during the war, and the vast majority of these were trainers and reconnaissance aircraft. Most of the bombers built in the United States during the war were of British design, and the first American bomber was still in development when the war came to an end.

assistant secretary of war for aviation. It was hoped that this reorganization would eliminate some of the institutional causes of the procurement bottleneck as well as head off calls for a completely independent air force.

The net effect of these delays was that American aviators saw little combat before the spring of 1918. When American air forces finally did swing into action, their operations were constrained by the equipment they had on hand and by existing command structures, both of which were shaped by prevailing organizational arrangements.

The main mission of the Signal Corps, of which the Aviation Section was a part until mid-1918, was gathering information about enemy movements and passing this information along to Army commanders on the ground. Predictably, the Signal Corps saw the airplane, first and foremost, as a new and improved way of fulfilling this mission. As a result, when the United States entered the war, 89 percent of the Army aircraft procurement program was devoted to observation aircraft and pursuit aircraft (now known as fighters), which the Signal Corps believed would be used mainly to protect reconnaissance operations.[12] American advocates of bombardment operations were thus constrained by the fact that few bombers came off American production lines and, of those that were fielded during the war, none had enough range to fly deep into German territory.

American advocates of bombardment operations were also constrained by the command arrangements under which they operated. Air squadrons were considered to be integral components of ground units, and final decisions about how air forces were used were made by the commanders of these units.[13] These commanders preferred to use the air forces at their disposal for reconnaissance, air defense, and close air support of ground operations rather than for strikes against distant military and industrial targets. Maj. William Mitchell, who became one of the country's most forceful advocates of strategic bombardment, recommended that American air forces in Europe be split into two main groups. He suggested that some units be assigned to ground forces, as they had always been, but also that some units be set aside for independent, strategic operations against enemy aircraft and materiel.[14] Mitchell's plan to set up an independent striking force was rejected by Gen. John Pershing, commander of the American Expeditionary Forces

12. Holley, *Ideas and Weapons*, p. 134.
13. Greer, *Development of Air Doctrine*, pp. 4–5.
14. Maj. William Mitchell, Memorandum for the Chief of Staff, U.S. Expeditionary Force, June 13, 1917, in Maurer Maurer, ed., *The U.S. Air Service in World War I*, 4 vols. (Washington: Government Printing Office, 1978–1979), vol. 2, p. 111.



in Europe, and American air forces consequently engaged in few sustained bombing campaigns during the war.

The most notable exception to this pattern took place in the final three months of the war, when Mitchell was put in charge of bombing campaigns against German forces at St. Mihiel and Meuse-Argonne. Several raids were carried out in September, October, and November 1918. The largest of these involved 1,500 aircraft, only one-third of which were assigned to ground commanders and two-thirds of which were under Mitchell's direct control. Although they sustained heavy losses, these large formations dominated the airspace over the battlefield and were able to execute their attacks on German ground forces, air fields, and communications posts. It is important to note that these attacks were not directed at the German economic infrastructure or other targets far behind the front lines; that is, they were not "strategic" campaigns in the sense of the term used in later years. They were tactical operations designed to support army operations on the ground.[15] In any event, they contributed significantly to the success of the Allied offensive, and they reinforced air power advocates' belief in the effectiveness of independently organized, highly concentrated bombardment operations.

Had the war continued beyond November 1918, the United States undoubtedly would have built more and better bombers, and American air forces in Europe undoubtedly would have engaged in more of the sustained bombing campaigns that were successful in the last few months of the conflict. Indeed, American aviators planned to attack German manufacturing and transportation centers in order to break supply lines to the German front. The few bombardment campaigns that took place during the war, however, were purely tactical in nature, and American bombers penetrated no more than 160 miles behind German lines during these operations.[16]

## American Air Power in the Interwar Years

The development of American air power in the interwar years revolved around three related issues: the crusade for bureaucratic autonomy waged by Army aviators; their efforts to develop and promote a distinct strategic bombardment doctrine; and their campaign to deploy large numbers of long-range bombers.[17] These issues were closely relat-

15. See Cate, "Air Service," pp. 10–16; Greer, *Development of Air Doctrine*, pp. 4–7; Goldberg, *History of the United States Air Force*, pp. 23–27.
16. Greer, *Development of Air Doctrine*, p. 11; Cate, "Air Service," p. 15.
17. James L. Cate and Wesley F. Craven, "The Army Air Arm between Two World Wars, 1919–1939," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 1, p. 17.

ed because, although air power advocates genuinely believed that the United States needed strategic bomber capabilities to defend itself, their case for bureaucratic autonomy rested on the claim that strategic bombardment was a distinct military mission that advanced bombers could carry out successfully. Bombardment doctrine and bombers were seen as strategic ends unto themselves, but they were also means to a parochial bureaucratic end.[18] Accordingly, the military establishment opposed this growing band of bomber advocates for both strategic and bureaucratic reasons. The Army and Navy genuinely believed, contrary to the claims of radical air power theorists, that ground and naval forces were still needed to provide for the common defense, but they also recognized that the arguments made by bomber advocates challenged their own claims on the scarce budgetary resources of the interwar period.

As the interwar period progressed, Army aviators were gradually given more bureaucratic autonomy. This came about through a series of small steps, each of which was intensely debated by the American military establishment.[19] In addition, strategic bombardment doctrine was refined in this period, and by the early 1930s a highly stylized conception of strategic bombardment operations had begun to emerge from the Air Corps Tactical School.[20] Although this doctrine was not embraced by

18. Perry McCoy Smith, *The Air Force Plans for Peace, 1943–1945* (Baltimore: Johns Hopkins Press, 1970), p. 17.

19. My discussion of the struggle for autonomy waged by air power advocates and the changing institutional relationship between the Army and its aviators in the interwar period is based on McClendon, *Question of Autonomy;* Smith, *Air Force Plans for Peace,* chap. 2; Harry Howe Ransom, "The Politics of Air Power: A Comparative Analysis," *Public Policy* (1958), 87–119; Cate and Craven, "Army Air Arm," pp. 17–71; Mooney and Layman, *Organization of Military Aeronautics, 1907–1935;* Chase C. Mooney, *Organization of Military Aeronautics, 1935–1945,* Historical Office, Headquarters Army Air Forces, April 1946; Maurer Maurer, *Aviation in the U.S. Army, 1919–1939* (Washington: Office of Air Force History, 1987); Goldberg, *History of the United States Air Force,* chap. 3; Robert W. Krauskopf, "The Army and the Strategic Bomber, 1930–1939," *Military Affairs* 22 (Summer 1958), 83–94, and 22 (Winter 1958–59), 208–215.

20. The classic treatise on the uses of air power is Giulio Douhet, *The Command of the Air* (New York: Coward-McCann, 1942), originally published in Italy in 1921. The evolution of William Mitchell's highly influential thinking can be tracked in his *Our Air Force* (New York: Dutton, 1921); *Winged Defense* (New York: Putnam's, 1925); and *Skyways* (Philadelphia: Lippincott, 1930). The best scholarly studies on the development of American strategic bombardment doctrine in the interwar period are Greer, *Development of Air Doctrine;* Robert T. Finney, *History of the Air Corps Tactical School, 1920–1940,* Research Studies Institute, Air University, March 1955; Robert F. Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force, 1907–1964,* 2 vols. Aerospace Studies Institute, Air University, June 1971,; Holley, *Ideas and Weapons,* chap. 10; James L. Cate, "Development of Air Doctrine," *Air University Quarterly Review* 1 (Winter 1947), 11–22; Cate and Craven, "Army Air Arm," pp. 33–54; Bernard Brodie, *Strategy in the Missile Age* (Princeton: Princeton University Press, 1959), chap. 3; Russell F. Weigley, *The American Way of War* (Bloomington: Indiana University Press, 1973), chap. 11; Edward Warner, "Douhet, Mitchell, Seversky: Theories of Air Warfare," in Edward M. Earle, ed., *Makers of Modern Strategy* (Princeton:



the American military establishment as a whole—far from it—it provided air power advocates with the conceptual framework they needed to formulate more specific performance requirements in their bomber acquisition programs. It was not a coincidence that, starting in the mid-1930s, Army aviators began to play a much more assertive role in initiating and shaping these programs. They soon developed a bomber that met their doctrinal requirements, but even in the late 1930s they had serious difficulty in securing funding for their acquisition efforts.[21] Although they came a long way over the course of the interwar period, bomber enthusiasts still found themselves in the U.S. Army when the United States entered World War II in late 1941.

The interwar period can be usefully divided into four phases, each capped by a formal change in the relationship between the Army and its aviators. The first phase ended with the passage of the Army Reorganization Act of 1920, which established the Air Service on a statutory basis. The second concluded with the passage of the Air Corps Act of 1926, which transformed the Air Service into the somewhat more autonomous Army Air Corps. The third ended with the establishment of an independent striking force, known as the General Headquarters Air Force, in 1935. The fourth and final phase concluded with the establishment of the semi-independent Army Air Forces in 1941.[22]

### *Lessons from the War: 1918–1920*

World War I ended before the efficacy of strategic bombardment could be put to a critical test. The American Air Service had no direct experience with strategic bombing, and, although British, French, and German air forces engaged in some attacks on industrial and urban centers, these attacks were scattered and did not have a decisive impact on the outcome of the war. The lack of clear-cut evidence about the military value

Princeton University Press, 1943), pp. 485–503; Ronald Schaffer, *Wings of Judgment* (New York: Oxford University Press, 1985), chap. 2; Michael S. Sherry, *The Rise of American Air Power* (New Haven: Yale University Press, 1987) chaps. 2–3; George Quester, *Deterrence before Hiroshima* (New York: Wiley, 1966), chap. 8; Smith, *Air Force Plans for Peace,* chap. 3.

21. The best sources on American bomber programs in the interwar period are Mary R. Self, *History of the Development and Production of USAF Heavy Bombardment Aircraft, 1917–1949,* Historical Office, Air Materiel Command (HO/AMC), Dec. 1950; Jean H. DuBuque and Robert F. Gleckner, *Development of the Heavy Bomber, 1918–1944,* Historical Division, Air University, Aug. 1951; Cate and Craven, "Army Air Arm,"pp. 54–71; Maurer, *Aviation in the U.S. Army,* chaps. 8, 12, 19; Alfred Goldberg, "AAF Aircraft of World War II," in Craven and Cate, eds., *Army Air Forces in World War II,* vol. 4, pp. 193–227; Goldberg, *History of the United States Air Force,* chaps. 3–4; Gordon Swanborough and Peter M. Bowers, *United States Military Aircraft since 1908* (London: Putnam, 1963).

22. This chronological framework was suggested by Cate and Craven, "Army Air Arm," p. 23.

of strategic bombardment allowed bomber enthusiasts and Army traditionalists to believe what they wanted to believe about the bomber's ability to transform warfare. As one study correctly observed, air power's potential was "sensed rather than tested" in 1918.[23]

Bomber enthusiasts believed that strategic bombardment would have played a significant role in the war had hostilities continued into 1919. They also believed that it would be decisive in future conflicts. They argued that, since infantry and artillery officers were mainly concerned about the tactical situation on the battlefield, bombardment operations would have to be organized by airmen if they were to be strategic in character and as effective as they could be. Some suggested that air forces be administered separately as part of a new Department of Defense. Others went so far as to recommend establishing a cabinet-level department of aeronautics equal in stature to the War and Navy departments and comparable to Britain's Royal Air Force (RAF), which had been established as an independent service in January 1918.[24]

Army traditionalists held fundamentally different views. Secretary of War Newton Baker believed that the just-concluded bombardment campaign had "no appreciable effect" on Germany's war-making capacity or, indeed, on the outcome of the war itself.[25] General Pershing, the Army's field commander during the war, argued that "an air force acting independently can of its own account neither win a war at the present time nor, so far as we can tell, at any time in the future." He believed that the air force's main mission should be "to drive off hostile airplanes and procure for the infantry and artillery information concerning the enemy's movements."[26] Predictably, Army traditionalists strongly opposed the idea of giving the Air Service any more operational or administrative autonomy.

A total of eight bills that would have established an independent department of aeronautics were introduced in Congress in 1919–1920, and three panels of experts were convened to review the institutional relationship between the Army and its aviators. Two of the panels, the Menoher board and the Dickman board, supported the status quo. The

23. Cate and Craven, "Army Air Arm," p. 34.

24. McClendon, *Question of Autonomy*, chap. 4; Cate and Craven, "Army Air Arm," pp. 17–24; Mooney and Layman, *Organization of Military Aeronautics*, chap. 2; Goldberg, *History of the United States Air Force*, chap. 3.

25. Baker quoted in Holley, *Ideas and Weapons*, p. 170. Given that the Army built few bombers and refused to allow the Air Service to bomb German industrial targets, it is not surprising that American air forces had little impact on Germany's war-making capacity. Under the circumstances, it was disingenuous to criticize the Air Service on these grounds.

26. Pershing quoted in Goldberg, *History of the United States Air Force*, p. 29, and in Krauskopf, "Army and the Strategic Bomber," p. 84.



findings of the Crowell board, which favored the establishment of a department of aeronautics, were deliberately suppressed by Secretary of War Baker, who had convened the panel in the first place.[27]

The Army's position ultimately carried the day in Congress. The Army Reorganization Act of 1920 established the Air Service as a branch of the Army on a statutory basis, and it specified that aviation would be the fourth regular combatant arm along with the infantry, cavalry, and artillery. Although the Reorganization Act required the Army to place pilots in command of tactical aviation units, it left the Army General Staff in charge of all major operational decisions. And, although the act gave the Air Service more day-to-day control over its acquisition programs, the War Department had the final word on the fate of these programs as well as on the size and shape of the Air Service's budget. The Air Service, moreover, would have less influence than ever over these decisions, because the position of assistant secretary of war for aviation, which was then vacant, was abolished.

Official Air Service statements about operational doctrine reflected the Army point of view during this period. A 1919 Air Service manual, for example, accepted the view that armies determined the outcomes of wars and that infantry was the heart of the army. According to this manual, "when the infantry loses, the Army loses."[28] Therefore, the mission of the Air Service and the other combatant arms was to support the infantry. An Air Service textbook written by the Army Command and General Staff School in 1920 observed that "teamwork with the ground troops" was "the basic idea" underlying the organization of aviation units.[29] Observation and pursuit aircraft were consequently held to be more important than bombers, and bomber target selection was to be made by the regular Army staff. A strategic striking force would be composed of whatever units were left after the tactical requirements of the ground forces had been satisfied.[30]

As for hardware, most of the Air Service's acquisition programs were canceled when defense budgets were slashed after the war. Even so, it was allowed to keep some of its British-designed DH-4 bombers in service and to continue work on the MB-2, a new bomber being developed by the Martin aircraft company in the United States.

27. According to Cate and Craven, "Army Air Arm," p. 24.

28. Col. Edgar S. Gorrell, *Air Service Notes on Recent Operations*, June 18, 1919, pp. 1–2; quoted in Greer, *Development of Air Doctrine*, p. 15.

29. E. L. Naiden, *Air Service* (Fort Leavenworth, Kans.: General Service Schools Press, 1920), p. 6.

30. As discussed in Holley, *Ideas and Weapons*, p. 172.

### The Air Service: 1920–1926

Air power advocates naturally resented being bridled by the Army in the early 1920s, and none was more bitterly resentful of this than Billy Mitchell, who had risen to the rank of brigadier general and the position of assistant chief of the Air Service. Mitchell became the country's most vocal proponent of air power and a thorn in the sides of his superiors, such as Maj. Gen. Charles Menoher, an artillery officer who had been made chief of the Air Service. Mitchell believed that "changes in military systems come about only through the pressure of public opinion or disaster in war," and, since the United States was unlikely to become involved in any major wars in the near future, he decided to mobilize public support for his crusade to pry the air force away from the Army.[31]

One of Mitchell's most extravagant claims was that "aviation will completely drive surface ships off the water in the next war," a contention that the Navy naturally rejected.[32] Mitchell convinced Congress to allow him to conduct some tests of bomber effectiveness and ship survivability, which he began in July 1921. In a series of attacks involving DH-4 and MB-2 bombers against captured German ships, Mitchell's planes sank a German destroyer and a cruiser and then the supposedly unsinkable battleship *Ostfriesland*.[33] When word of Mitchell's success was leaked to the press, Menoher decided that the Air Service was not big enough for both of them. When the secretary of war refused to sack Mitchell, who had allies in Congress, Menoher resigned. He was replaced as chief of the Air Service by Maj. Gen. Mason Patrick, an Army engineer who said in 1918 that he had never seen an airplane, "save casually."[34] Mitchell's bombers went on to sink a retired U.S. Navy battleship in September, which led him to proclaim that land-based aircraft were needed for coastal defense. The Navy argued that tests against defenseless ships proved nothing and that strong naval forces still constituted the nation's first line of defense.[35]

Although Mitchell championed the cause of air power in the early 1920s, he did not argue that the Army's air force should be composed primarily of bombers, contrary to what one might have expected. Mitchell recognized that the bombers then in service and on the drawing boards were technologically primitive; they would not be able to survive attacks by high-speed interceptors. He concluded that a large force of pursuit aircraft would be needed to sweep aside enemy air defenses in

31. Mitchell quoted in Ransom, "Politics of Air Power," p. 113.
32. Mitchell quoted in Greer, *Development of Air Doctrine*, p. 36.
33. See Maurer, *Aviation in the U.S. Army*, pp. 113–121.
34. Patrick quoted in Collier, *History of Air Power*, p. 77.
35. Greer, *Development of Air Doctrine*, pp. 30–36. Air Service bombers also sank two retired U.S. Navy battleships in September 1923.



the first stages of a war. Pursuit aircraft would also be needed for air defense purposes. Mitchell consequently recommended that 60 percent of the air force be composed of pursuit aircraft, 20 percent bombers, and 20 percent attack aircraft designed to support operations on the ground.[36] Mitchell's vision of how this air force should be organized differed sharply from the plan the Air Service put together in 1921, which called for a force of twenty-seven squadrons, nineteen of which would be observation or surveillance units, four of which pursuit outfits, and four of which bomber units. Reconnaissance was emphasized at the expense of both pursuit and bombardment.[37]

It was certainly true that the American bombers in service in the early 1920s had limited capabilities. The Martin MB-2, the most advanced bomber in the inventory, was designed during the war and, like most of the bombers of this era, was a two-engine biplane. It had a top speed of only 99 mph, a ceiling of only 10,000 feet, and a total range of 550 miles. The Barling NBL-1 bomber, which first flew in 1923, was a much larger six-engine aircraft. This underpowered airplane had a top speed of only 95 mph, and its ceiling was so low that it failed to get over the Appalachian Mountains in flight tests. Although bomber enthusiasts in the Air Service hoped to deploy a large, multiengine bomber some day, the NBL-1 was a disappointment and only one prototype was built. The Curtiss B-2, which first took to the air in 1924, was another two-engine biplane, and it too had a top speed of around 100 mph. Pursuit aircraft did not have to carry heavy payloads or fly long distances, which allowed aircraft designers to maximize speed and altitude capabilities in these systems. As a result, pursuit aircraft of the mid-1920s had top speeds of 180 mph and service ceilings of 22,000 feet. These capabilities would have given air defenses a decisive advantage over unescorted bombers in an actual engagement.[38]

Bomber development lagged because it was inherently difficult, but also because it was not one of the Army's top priorities, to put it mildly. Little money was set aside for aviation activities in general in the mid-1920s. Air Service expenditures for fiscal years 1924–26 averaged only $12.5 million per year, approximately 2 percent of the total spent on national defense.[39] Although the Air Service set aside almost 25 percent of its budget for research and development during this period, most of

36. Holley, *Ideas and Weapons*, p. 167. See also Greer, *Development of Air Doctrine*, pp. 30–31, 36–38.
37. Goldberg, *History of the United States Air Force*, p. 30.
38. The MB-2 was also known as the NBS-1, and the B-2 was also known as the NBS-4; see ibid., pp. 16, 30, 32; Maurer, *Aviation in the U.S. Army*, pp. 81, 126, 214; Self, *History of the Development and Production of USAF Heavy Bombardment Aircraft*, pp. 10–11; Cate and Craven, "Army Air Arm," p. 58.
39. Derived from Ransom, "Politics of Air Power," p. 116.

this was spent on pursuit, attack, and observation aircraft.[40] Inevitably, this affected the progress of bomber technology. Small expenditures also affected the number of bombers the Air Service could buy for the active inventory. In fact, the Air Service failed to build a single bomber in 1923 and 1924, and it had only 59 bombers in service in 1924. It managed to add only two bombers to the force in 1925 and one in 1926.[41]

The Army also exercised as much control as it could over doctrinal matters during this period. The 1923 Field Service Regulations maintained that "the ultimate objective of all military operations is the destruction of the enemy's armed forces by battle" and that "the combined employment of all arms is essential to success." It continued, "The coordinating principle which underlies the employment of combined arms is that the mission of the infantry is the general mission of the entire force. The special missions of the other arms are derived from their powers to contribute to the execution of the infantry mission." Observation, close air support, and pursuit aircraft were therefore needed for obvious reasons. Bombers had an important contribution to make, but mainly in terms of attacking tactical targets beyond the range of artillery.[42] As a textbook on the Air Service prepared for the Army's Command and General Staff College declared, tactical bombing was "a necessity" and strategic bombing "a luxury."[43]

These doctrinal discussions took place in the context of another debate over the Air Service's institutional relationship with the Army. Mitchell continued to agitate for more autonomy, and two high-level review boards convened in the mid-1920s agreed with him. The Lassiter board of 1923 recommended creating an independent force of bombers and pursuit aircraft under General Headquarters Command; this force would concentrate more on strategic operations. This recommendation was not implemented by the War Department. The Lampert committee of the House of Representatives went further in 1925 when it recommended creating an administratively independent air force, as well as a Cabinet-level department of defense that would supervise the activities of all the military services.[44]

40. Goldberg, *History of the United States Air Force*, p. 33.
41. Holley, *Ideas and Weapons*, p. 172; Goldberg, *History of the United States Air Force*, p. 32.
42. *Field Service Regulations* (Washington: U.S. Army, 1923), pp. 11, 22–23, 77. Similar arguments were outlined in *Fundamental Conceptions* (Washington: Air Service, 1923), pp. 1–2.
43. U.S. Army Command and General Staff College, *Corps and the Army Air Service* (Fort Leavenworth, Kans.: General Service Schools Press, 1922), p. 26.
44. See McClendon, *Question of Autonomy*, chap. 5; Mooney and Layman, *Organization of Military Aeronautics*, chap. 3; Cate and Craven, "Army Air Arm," pp. 24–29; Greer, *Development of Air Doctrine*, pp. 26–29; Goldberg, *History of the United States Air Force*, p. 36.





At the same time, several factors worked against Mitchell and his cohorts. Many people remembered the bold claims made in 1917 about the impact American air power would have on the war in Europe; this undermined the credibility of the sweeping claims made by air power advocates less than ten years later. Given the isolationist and pacifist sentiments that dominated the American policy debate in the mid-1920s, it was also hard to argue for military forces that would be capable of engaging in offensive military operations, which bomber forces would certainly be able to do. And given that the most advanced aircraft then in service anywhere had an effective operating radius of only 300–350 miles, the United States faced no immediate threat from the air; it was hard to argue for stronger air forces on these grounds.[45] In any case, despite Mitchell's success in sinking old battleships in carefully staged exercises, most policy makers still assumed that the Navy would provide the nation with its first line of defense against overseas attack. Air forces might constitute a second line of defense, but this was not a sufficient reason for creating an expensive, independent service. Another high-level review panel, the Morrow board, recommended in late 1925 that the Air Service not be given its independence and that a new department of defense not be created. It favored the status quo, although it noted that steps should be taken to raise the Air Service's status and to increase its level of representation on the Army General Staff and in the War Department. Above all, the Army and Navy, which had strong vested interests in the status quo and were powerful political actors in Washington, were opposed to the idea of spending a great deal of money on Army aviation forces, redefining the Air Service's military mission in any fundamental way, or granting the Air Service much operational or administrative autonomy.

Ultimately, the Air Corps Act of July 1926 made only a few changes in the Army's relationship with its aviators. It elevated the status of the Army's air force from a service to a corps, and it reestablished the position of assistant secretary of war for aviation, which gave the new Army Air Corps (AAC) more input into War Department decisions. More significant, it gave the Army's aviators more control over their budget, which in the long run allowed them to devote more effort to developing the kind of highly capable, long-range bombers unofficial air force thinking called for. Finally, the Air Corps Act marked a turning point in official thinking on the uses of air power when it noted that these steps should strengthen "the conception of military aviation as an offensive, striking arm rather than an auxiliary service."[46]

45. These points are developed in Ransom, "Politics of Air Power," pp. 107–117.
46. Quoted in Goldberg, *History of the United States Air Force*, p. 36. The creation and provisions of the Air Corps Act are discussed in the sources cited in note 44.

In fact, air power advocates had already started to stake out radical positions on bomber operations. Mitchell was court-martialed in late 1925 after he accused the Army and Navy high commands of "incompetency, criminal negligence, and almost treasonous administration of the national defense," and he resigned his commission in February 1926 rather than suffer through a five-year assignment in San Antonio.[47] Freed completely from bureaucratic constraints, he began to place more emphasis on the ability of bomber forces to destroy the enemy's vital industrial centers quickly and he began to play down the role of pursuit aircraft in offensive operations.[48]

Two textbooks published by the Air Service Tactical School in 1926 also stated what were, from an official standpoint, heretical positions on how bomber operations should be conducted. The *Employment of Combined Air Force* manual began by declaring that the primary objective of air operations was not to assist in the destruction of the enemy's ground forces but to take the lead in destroying the enemy's capacity and will to continue. It went on to say that the best way to bring about an enemy's economic collapse and a quick end to a war was "heavily striking vital points rather than gradually wearing down an enemy to exhaustion."[49] The textbook for the bombardment course at the tactical school stated that these industrial targets must be selected with care. According to this manual, it would be "wrong to send out planes simply to drop their bombs when over a large target."[50] Finally, the *Employment* manual argued that bomber offensives would be difficult to stop in the future because bombers would have the edge over pursuit aircraft. It therefore considered bombers to be the most important element in the air force.[51] These themes—the independent and decisive nature of strategic bombardment operations, the importance of targeting vital economic centers, and the ascendancy of bombardment over pursuit—would become main pillars of the strategic bombardment doctrine that was refined in the Air Corps Tactical School in subsequent years.

Although the Air Corps Act of 1926 addressed several chronic organizational issues, it did not resolve the underlying doctrinal dispute that kept the Army and its aviators at odds. In fact, it aggravated this dispute by giving credence to the claim that aircraft should be used as independent striking forces and not just as adjuncts to infantry operations.

47. Mitchell quoted in Goldberg, *History of the United States Air Force*, p. 32.
48. See Weigley, *American Way of War*, chap. 11; Cate and Craven, "Army Air Arm," pp. 33–43; Schaffer, *Wings of Judgment*, pp. 25–27.
49. Air Service Tactical School, *Employment of Combined Air Force* (Washington: Government Printing Office, 1926), pp. 3–4. See also Greer, *Development of Air Doctrine*, pp. 40–43.
50. Air Service Tactical School, *Bombardment* (Washington: Government Printing Office, 1926), p. 63.
51. *Employment of Combined Air Force*, pp. 9–11, 23–24.



Doctrinal controversy would become even more intense once bombers developed the capacity to carry out long-range offensive missions.[52]

### *The Army Air Corps: 1926–1935*

Bomber enthusiasts were anxious to build high-performance bombers in the late 1920s, but they were constrained by three things.

First, the technological state of the art prevented high-speed aircraft from carrying heavy payloads long distances. The bombers of the late 1920s—such as the Curtiss B-2 and the Keystone B-3, B-4, B-5, and B-6—were all biplanes, and they could not fly very fast or very far. The B-4, for example, had a top speed of 120 mph and a range of 850 miles.[53]

Second, the Army continued to supervise the AAC acquisition program, and it tried to keep the AAC from building highly specialized aircraft optimized for long-range bombardment missions. In 1929, for example, the Army shelved an AAC proposal to develop a high-speed, heavily armed bomber. Instead, it forced the AAC to buy a mediocre all-purpose plane that was also designed to perform reconnaissance and close air support missions.[54] This short-range, lightly armed aircraft—the Douglas O-35, also known as the B-7—was incapable of flying long-range missions over heavily defended targets, which the AAC hoped to do.

Third, although the AAC's annual expenditures increased to an average of $22 million in the late 1920s, this was not enough to sustain a full-scale modernization of the entire air force.[55] Priorities had to be established, and bomber modernization was at the bottom of the Army's priority list.

Bomber development reached a watershed in 1930 when the Army gave the AAC permission to launch a design competition for a specialized, high-performance bomber. The fact that Army budgets were rising sharply at the time seems to have influenced its decision to allow some leeway on this issue.[56] In any event, the AAC wasted little time in circulating a request for proposals to the aircraft industry. Six companies responded by building experimental prototypes, the most promising of which were two twin-engine aircraft, Boeing's B-9 and Martin's B-10. Both aircraft incorporated several technological advances. Most important, they were all-metal monoplanes with retractable landing gear.

52. Discussed in Greer, *Development of Air Doctrine*, p. 43.
53. Maurer, *Aviation in the U.S. Army*, pp. 214–215.
54. Cate and Craven, "Army Air Arm," p. 59.
55. Ransom, "Politics of Air Power," p. 116; Edwin H. Rutkowski, *The Politics of Military Aviation Procurement, 1926–1934* (Columbus: Ohio State University Press, 1966), chap. 2.
56. Ransom, "Politics of Air Power," p. 116.

These improvements reduced aerodynamic drag and enabled the aircraft to slice through the air relatively cleanly and efficiently. This, in turn, dramatically improved their performance. The B-9, which first flew in April 1931, had a top speed of 188 mph, more than 60 mph faster than the biplane bombers then in service. The B-10, which first flew in July 1932, was even more advanced in that it featured an internal bomb bay. The B-10's top speed was over 200 mph, faster than any pursuit aircraft in the U.S. inventory. It could fly at 21,000 feet, 50 percent higher than the B-4, and its production version had a range of 1,240 miles. The AAC ultimately bought seven B-9s and 152 B-10s of various makes and models.[57]

Other important technological developments were also taking place around this time. Most notably, the advanced Norden Mark XV bombsight was tested in October 1931. The AAC conducted extensive tests of this new bombsight in 1932 and placed a production order for the Norden system in 1933. To keep up the competitive pressure and maintain an alternative source of supply, the AAC also placed an order with the Sperry Gyroscope Company in 1933 for models of its advanced bombsights.[58]

Meanwhile, the AAC continued to push ahead with long-range bomber development. It issued a request for proposals in December 1933, calling for a bomber capable of carrying a 2,000-pound payload on a 5,000-mile mission at a speed of 200 mph. These were extremely demanding requirements, given that the B-10 could fly only a fraction of this distance with a comparable payload. Boeing won a development contract in 1935 to build the B-15, which first flew in October 1937. Flight testing subsequently revealed that it could not meet the AAC's original performance requirements. It could fly 5,000 miles and reach speeds of 195 mph without a payload, but with a full payload it could fly only 3,500 miles at 145 mph; it would be too slow to survive against high-speed air defense interceptors. The B-15 was simply too large and too heavy for the engines that were available, even though it was powered by four engines. These technical problems, in conjunction with Army opposition to building large numbers of long-range bombers, led to a decision to build only one B-15 prototype.[59]

57. The B-12, B-13, and B-14 were advanced versions of the B-10; see DuBuque and Gleckner, *Development of the Heavy Bomber*, pp. 70–72; Swanborough and Bowers, *United States Military Aircraft*, pp. 85, 375–378.

58. James L. Cate, "Plans, Policies, and Organization," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 1, pp. 598–599.

59. DuBuque and Gleckner, *Development of the Heavy Bomber*, pp. 83–86; Self, *History of the Development and Production of USAF Heavy Bombardment Aircraft*, pp. 16–17; Krauskopf, "Army and the Strategic Bomber," pp. 91–92; Goldberg, "AAF Aircraft," p. 202; Cate and





Another development program was launched in May 1934 when the AAC announced a design competition for a high-speed, long-range, multiengine bomber. Boeing was the only contractor to submit a proposal for a four-engine aircraft, which gave it a decisive advantage over the competition; two-engine bombers had comparatively limited speed and payload capabilities. Boeing won a contract to build a prototype of what became known as the B-17. The first flight of this aerodynamically clean aircraft took place in July 1935, and the new bomber quickly went on to demonstrate impressive performance capabilities. It had a top speed of over 250 mph, a service ceiling of over 30,000 feet, and a maximum payload of over 10,000 pounds. In one test it flew 2,100 miles at an average speed of 232 mph. The heavily armed bomber also had five machine gun turrets, which led people to call it the Flying Fortress. The B-17 was the bomber of the AAC's doctrinal dreams, and bomber enthusiasts lobbied intensively to buy 65 B-17s straight away; the War Department cut this request back to 13 aircraft. The rest of the decade saw a continuing tug of war between the AAC and the War Department over B-17 production. The AAC wanted to buy enough B-17s to field a legitimate strategic striking force, while the War Department wanted the AAC to buy less capable but more versatile aircraft.[60]

All these programs were shaped by the AAC's prevailing conception of air power, which as early as 1926 explicitly emphasized bombardment operations against selected economic and industrial targets. Operations of this type could not be conducted, however, given the bombers in service in the late 1920s. The AAC needed bombers capable of flying long distances, penetrating stiff air defenses, and delivering large payloads accurately. The bombers of the late 1920s could do none of these things, let alone all of them. There was, therefore, an emerging doctrinal imperative for a bomber with impressive range, speed, altitude, defensive armament, payload, and bomb delivery capabilities.

This doctrinal imperative, in its formative stages in the late 1920s, became substantially more explicit in the early 1930s. In many respects, important refinements appeared in AAC thinking *before* technological developments took place that would make them practicable. In many respects, doctrine *called for* new technology and new weapon systems; it did not flow from them. For example, the primacy of strategic bombardment operations was firmly established at the Air Corps Tactical School

Craven, "Army Air Arm," pp. 63–66; Swanborough and Bowers, *United States Military Aircraft*, p. 540.

60. DuBuque and Gleckner, *Development of the Heavy Bomber*, pp. 74–80; Self, *History of the Development and Production of USAF Heavy Bombardment Aircraft*, pp. 17–20; Goldberg, "AAF Aircraft," pp. 203–208; Cate and Craven, "Army Air Arm," pp. 66–69; Swanborough and Bowers, *United States Military Aircraft*, pp. 87–96.

in 1930, long before a real strategic bomber had been built. Some instructors at the school argued in 1930 that pursuit aircraft would not be able to stop bombardment operations, one year before the B-9 took to the air, two years before the B-10 began its testing program, and roughly five years before the B-17 made its first flight. Textbooks published at the Tactical School in 1931 stressed that new bombsights would be needed to achieve the accuracy necessary to carry out effective bombardment operations. They also began to argue in 1931 that bombardment operations would have to be conducted in daylight if precise attacks were to be successful. These arguments were developed before the Norden and Sperry bombsights were fully tested and before a bomber capable of surviving daylight operations, such as the B-10 or B-17, had flown.[61] In all these respects, doctrine demanded new technologies and better bombers. Given that this doctrine had already begun to take shape by the early 1930s, it is not surprising that the AAC guided the requirements formation process for the B-15 and B-17 with a firm hand.

At the same time, it would be simplistic to argue that AAC doctrine was immune to the influence of technological developments in the early 1930s. AAC thinking was still in a formative stage during this period, and technological developments played an important role in reinforcing emerging doctrinal currents and suggesting doctrinal refinements. For example, the emergence of the B-9 and B-10 in the early 1930s buttressed the claims made by bomber enthusiasts about the feasibility of bombardment operations. It also suggested that high-speed bombers might not need pursuit escorts, which was still a bone of contention at the Air Corps Tactical School. The development of the Norden bombsight led instructors at the school to look more closely at the possibility of bombing targets with pinpoint accuracy. It was not a coincidence that the Air Corps Tactical School began to stress the importance of targeting specific economic chokepoints in 1933, after the capabilities of the Norden bombsight became clear. And the appearance of the high-speed, heavily armed B-17 ended the debate over pursuit escorts for the rest of the decade. Received wisdom subsequently held that advanced bombers would not need escorts.[62]

It is generally agreed that the AAC's theory of strategic bombardment came together by 1935. This theory consisted of five main propositions.[63]

First and most generally, the AAC argued that air power was decisive in warfare and that bombardment was the dominant form of air power.

61. See Finney, *History of the Air Corps Tactical School*, pp. 31–32.
62. See ibid., pp. 31–33, 38; Greer, *Development of Air Doctrine*, pp. 57–59; Goldberg, *History of the United States Air Force*, p. 44.
63. This discussion is based on the sources cited in note 20.





This view was based on the conviction that bombardment operations would determine the course of future military conflicts, but it was also true that the AAC needed to establish for purely bureaucratic reasons that it had a distinct, autonomous military mission to perform. Its case for institutional independence from the Army rested on the claim that air forces were more than adjuncts to ground operations. Therefore, bureaucratic motivations also led the AAC to adopt bombardment as its primary military mission.[64]

Second, the AAC argued that bombardment would be most effective when it was directed at an enemy's economic infrastructure and war-making capacity. Attacking an enemy's military forces was held to be important only in that one had to destroy enemy bombers and air defenses to establish command of the air. The AAC believed that ground and naval forces would be highly vulnerable to attack from the air, but it maintained that wars could be won more quickly and more easily by destroying an enemy's economic support system. This strategic argument was reinforced by a bureaucratic concern. If bombardment operations focused on battlefield forces, they would tend to become tactical in character, auxiliary in nature, and subject to the influence of Army commanders on the ground. In defending the strategic character of bombardment operations, the AAC was also safeguarding its operational independence.

In addition, the AAC rejected the idea of targeting urban residential areas per se. It did not believe, as the RAF did, that civilian morale should be a main focus of strategic operations.[65] The AAC argued that it would be easier to destroy an enemy's war-making capacity than to undermine civilian morale. This strategic argument was reinforced by moral and practical considerations. Not only was the idea of deliberately attacking civilians abhorrent to many Americans, including many airmen, but from a practical standpoint a doctrine that called for attacking civilians was unlikely to become national policy and an organization that advocated operations of this type was unlikely to receive strong political support from any quarter.[66] This was an important political consideration given that the AAC, unlike the RAF, was still trying to win its independence from the Army.

64. This point is developed in Smith, *Air Force Plans for Peace*, chap. 2; Ransom, "Politics of Air Power," pp. 107–117.
65. For more on British strategic bombardment doctrine and how it differed from the American conception, see Barry D. Powers, *Strategy without Slide-Rule* (London: Croom Helm, 1976), chaps. 5–6; Williamson Murray, "British and German Air Doctrine between the Wars," *Air University Review* 31 (March–April 1980), 39–58; Cate and Craven, "Army Air Arm," pp. 33–54; Quester, *Deterrence before Hiroshima*, chaps. 5, 7–8.
66. For a discussion of the moral choices faced by American airmen in World War II, see Schaffer's excellent study, *Wings of Judgment*.

Third, the AAC argued that the most effective way of crippling an enemy's economy was to bomb key industries thoroughly. No doubt influenced by the unfolding events of the Great Depression, AAC strategists believed that modern economies were highly interdependent and consequently "brittle." They argued that a country's "industrial web" contained a few key industries or "vital centers," the destruction of which would paralyze the economy as a whole, and they concluded that the challenge for air force planners was to identify a country's economic "solar plexus" so that focused but intense attacks could create systemwide "bottlenecks." The AAC suggested that petroleum and steel industries, power-generating facilities, and transportation and communications centers were likely targets.[67] In this respect, too, AAC thinking differed from that of the RAF, which favored more widespread—some would say indiscriminate—attacks on large industrial and urban areas. The AAC believed that scattered attacks on large areas were unlikely to induce economic collapse.

This strategic argument was also buttressed by practical considerations. One of strategic bombardment's main attractions was that it appeared to make wars of attrition things of the past; AAC doctrine reinforced this impression especially well. In addition, the AAC's elaborate economic targeting plans appeared to be the product of a rigorous, scientific exercise, which enhanced their credibility. Moreover, it appeared that aerial blitzkrieg attacks could be carried out by a relatively small fleet of bombers, an important consideration given that defense budgets were tight in the mid-1930s. AAC plans therefore seemed to be both economical and affordable.

Fourth, the AAC argued that air forces had to be capable of conducting attacks with pinpoint accuracy in order to destroy well-defined economic targets; thus, it favored daylight bombing operations. Again, AAC thinking differed from that of the RAF. British strategists found in World War I that bombing accuracy was poor even during the day; they also argued that daylight operations were hazardous because air defenses were especially stiff during the day. The AAC maintained, however, that technological advances since World War I had improved bombing accuracy significantly and that modern, high-performance

67. AAC thinking diverged from that of Douhet, who advocated indiscriminate attacks on urban centers and said little about target selection. See Finney, *History of the Air Corps Tactical School*, pp. 30–34; Greer, *Development of Air Doctrine*, pp. 57–60; Futrell, *Ideas, Concepts, Doctrine*, pp. 55–86; Cate and Craven, "Army Air Arm," pp. 33–54; Cate, "Development of Air Doctrine," pp. 19–21; Smith, *Air Force Plans for Peace*, pp. 27–38; Weigley, *American Way of War*, pp. 236, 337.



bombers would be much less vulnerable to air defenses than their distant ancestors.[68]

Once again, the AAC's strategic arguments were reinforced by pragmatic considerations. American military strategy had a strong defensive orientation in the 1930s, and American military and political leaders were unlikely to adopt an offensive scheme like strategic bombardment in the immediate future. At the time, the AAC's only official long-range mission was providing for land-based coastal defense. According to an agreement reached between the Army and the Navy in 1931, AAC aircraft were to help defend American coasts and important sea lanes from naval attack, the only real threat the United States faced at the time. To do this, the AAC was allowed to buy a small fleet of long-range bombers (B-10s and, later, B-17s). These bombers had to be capable of attacking moving ships; this required accurate bomb delivery. So, the best way for the AAC to build a strategic striking force out of the force it had on hand was to adopt an operational doctrine that could be carried out by a relatively small fleet of highly accurate bombers.[69]

Fifth, the AAC argued that high-performance bombers would be able to attack targets far behind enemy lines without the benefit of pursuit escorts. It believed that many enemy air defense aircraft would be caught on the ground and that many enemy air defense bases would be knocked out of commission in the early rounds of the next war. Moreover, it believed that high-performance bombers would be capable of defending themselves against remaining air defenses: bombers would avoid air defenses by flying at high altitudes, beyond the reach of antiaircraft guns and low-altitude interceptors; fast-flying bombers would outrun the interceptors that could climb to high altitudes; and large formations of heavily armed bombers would outgun the aircraft they could not outrun. The AAC's belief in the invincibility of the bomber led it to put little effort into escort development in the late 1930s, a decision many bomber pilots would rue in 1942 and 1943.[70]

68. American air power strategists were critical of the British approach to strategic bombardment even in the years immediately after the war; see the narrative summary to the U.S. Bombing Survey for World War I in Maurer, ed., *U.S. Air Service in World War I*, vol. 4, pp. 495–503. British strategists became more adamant in their views after the Battle of Britain in 1940, and they were reluctant to participate in daylight operations during World War II even though long-range escort capabilities improved as the war wore on; see Weigley, *American Way of War*, pp. 354–356.

69. Because of these constraints, the AAC invariably justified requests for long-range bombers in terms of coastal defense and reinforcement of outlying possessions. This was certainly true for the B-10, B-15, and B-17 in the 1930s; see Goldberg, *History of the United States Air Force*, pp. 38–42.

70. Finney, *History of the Air Corps Tactical School*, p. 32. See also Bernard L. Boylan, "The Search for a Long Range Escort Plane, 1919–1945," *Military Affairs* 30 (Summer 1966),

Bureaucratic considerations also led the AAC to neglect escort aircraft in the 1930s. The case for the strategic bomber would have been weakened if bombers were seen as vulnerable to air defenses and dependent on pursuit escort, and spending money on escort development and procurement would have diverted resources away from bomber programs, which were already underfunded as far as the AAC was concerned. The AAC was convinced, in any event, that it would be extremely difficult, if not impossible, to build a long-range escort.

This strategic bombardment doctrine could be carried out only if very advanced bombers could be built. These bombers would need impressive performance capabilities in no less than six areas: range, altitude, speed, defensive armament, payload, and accuracy.[71] There were inherent trade-offs in these doctrinally driven performance requirements, however. For example, if everything else was equal, one had to sacrifice aircraft speed to get more range, and vice versa. Similarly, a heavily armed bomber could not carry as much payload as a lightly armed aircraft, and it was hard to fly a heavily armed bomber with a big payload far. In addition, bombing accuracy decreased when bombers flew higher and faster. The AAC tended to ignore these trade-offs and push performance requirements in many areas simultaneously, as it did in the B-15, B-17, and later programs.

Although the AAC's strategic bombardment doctrine was fully developed by the mid-1930s, it still had to justify bomber procurement in terms of coastal defense requirements. American military and political leaders were not yet convinced that the country needed a bomber force per se. The Baker board of 1934, chaired by former War Department Secretary Newton Baker and composed of four ground officers and only one aviator, maintained that "the idea that aviation, acting alone, can control the sea lanes, defend the coast, or produce decisive results in any other general mission contemplated under our policy is visionary, as is the idea that a very large and independent air force is necessary to defend our country against air attack."[72]

The Baker board believed that the AAC should remain part of the Army, under General Staff control, but it recognized that public sentiment was moving in the direction of establishing an independent air force.[73] Twelve bills calling for an independent department of aeronautics and seventeen bills calling for an independent air force under the supervision of a department of defense had been considered by Congress since 1926. More ominous, the Federal Aviation Commission's Howell board was expected to recommend setting up the AAC as a separate department when it issued its report in early 1935. With this in mind, the Baker board offered a compromise: a General Headquarters Air Force that would be composed of all AAC combat units and trained as a homogenous organization but would still be under the control of the Army chief of staff in peacetime and Army field commanders in time of war. These limitations notwithstanding, AAC leaders welcomed the General Headquarters Air Force as a step forward; it provided for the operational unification of Army air forces and creation of a bomber force that could be used in strategic operations. The Howell board subsequently decided to give the new organizational experiment a fair trial rather than recommend more radical reforms, and the General Headquarters Air Force was activated in March 1935.[74]

57–67. One of the technological developments AAC strategists did not foresee in the 1930s was radar, which would alert air defenses to approaching bombers and provide more time for interception. Nor did the AAC expect the speed capabilities of air defense aircraft to improve as much as they did in the late 1930s. As Greer, *Development of Air Doctrine*, p. 58, pointed out, the effectiveness of air defense aircraft was at an all-time low in the early 1930s, when AAC strategic bombardment doctrine came together.

71. The RAF, on the other hand, emphasized nighttime operations, so its bombers did not have to be particularly fast or heavily armed. RAF bombers did, however, carry big payloads to compensate for their lack of accuracy.

72. Quoted in Krauskopf, "Army and the Strategic Bomber," pp. 88–89.



### *Preparations for War: 1935–1941*

The AAC continued to press for bomber development and production in the late 1930s, especially for long-range systems that could be used for either coastal defense or strategic bombardment. It was opposed in this by the Army, which believed that the AAC had been "led astray by the allurement of a quest for the ultimate in aircraft performance at the expense of practical military need."[75] As far as the Army was concerned, the most important of these practical needs included close air support and tactical bombardment capabilities, neither of which required long-range aircraft. The AAC was also opposed by the Navy, which resented and felt threatened by the AAC's growing interest in coastal defense, traditionally one of the Navy's most important contributions to national security.[76]

One of the AAC's most ambitious programs in the 1930s was the B-19. Its goal was to build an aircraft capable of carrying a 2,400-pound

73. William A. Goss, "Origins of the Army Air Forces," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 6, p. 3.

74. Based on Krauskopf, "Army and the Strategic Bomber," pp. 88–90; Cate and Craven, "Army Air Arm," pp. 29–32; McClendon, *Question of Autonomy*, chap. 6; Mooney and Layman, *Organization of Military Aeronautics*, chap. 4; Maurer, *Aviation in the U.S. Army*, chaps. 16–18.

75. According to Goldberg, *History of the United States Air Force*, p. 42.

76. As discussed in Greer, *Development of Air Doctrine*, pp. 89–91.

payload on an 8,000-mile mission, 60 percent farther than the B-15 was to fly with a smaller payload. The B-19 program was launched in October 1935, when the Douglas Aircraft Corporation began design development. The program soon attracted the attention of the Army General Staff, which opposed it on the grounds that it would be "an airplane of aggression."[77] In August 1936, the AAC was given permission to build one B-19 prototype, but only because the program was already under way and the Army did not want to risk damaging the government's reputation as a reliable research and development partner. The Army made it clear, however, that further development of the new bomber was unlikely, and production was simply out of the question. As it turned out, Douglas had difficulty building an aircraft capable of meeting the AAC's extremely demanding requirements. The first flight of the B-19 did not take place until June 1941, and, although the B-19 could fly 7,800 miles without a payload, it could fly only 5,200 miles with a 2,500-pound payload. And, as in the case of the B-15, the lumbering B-19 would have been highly vulnerable to high-speed air defense aircraft.[78]

The Army and the AAC also disagreed over the size and pace of the B-17 production program. The AAC's running battle with the Army to build more B-17s came to a climax in May 1938, after three B-17s intercepted the Italian liner *Rex* 725 miles east of New York City in an offshore exercise. The Navy, outraged by the AAC's encroachment on its sea-lane defense mission, pressed the Army to renegotiate their understanding on the AAC's offshore operations. The Army, anxious to corral the AAC for its own reasons, agreed. The Army chief of staff and the chief of naval operations subsequently decided that AAC coastal defense operations would no longer extend beyond 100 miles of the U.S. coast. This decision swept away the AAC's official justification for building the B-17 and longer-range bombers. In June, Secretary of War Harry Woodring told the AAC that it would be allowed to buy only 13 B-17s in fiscal year 1939 and only light, medium, and attack bombers—no B-17s—in 1940. The AAC was left with a total of 52 B-17s on order, as well as 350 of the shorter-range, twin-engine B-18s the Army General Staff preferred. According to the Army's deputy chief of staff, only a relatively small number of B-17s was needed to reinforce Hawaii, Alaska, and Panama, and no plane larger than the B-17 was needed. The Army consequently

77. Quoted in Krauskopf, "Army and the Strategic Bomber," p. 85.

78. See DuBuque and Gleckner, *Development of the Heavy Bomber*, pp. 87–88; Self, *History of the Development and Production of USAF Heavy Bombardment Aircraft*, pp. 21–22; Krauskopf, "Army and the Strategic Bomber," pp. 85, 92–93; Cate and Craven, "Army Air Arm," p. 69; Greer, *Development of Air Doctrine*, pp. 96–97; Swanborough and Bowers, *United States Military Aircraft*, p. 556. See also "XB-19," April 30, 1943, Aircraft Projects (Bombers), RG 341, HQ/U.S. Air Force (USAF), National Archives and Records Service (NARS).



turned down the AAC's request to build a longer-range version of the B-17, an aircraft that would be known as the B-29 when the Army changed its mind in 1940.[79]

The deteriorating situation in Europe soon led American political and military leaders to reassess the country's military preparedness and procurement priorities. Although Germany's rearmament program had been under way for some time, its significance was not driven home to most American observers until September 1938, when Britain and France acquiesced at Munich to Hitler's demand that Czechoslovakia cede the Sudetenland. President Roosevelt believed that the threat implied by the existence of a powerful German air force played an important role in Hitler's success at Munich, and Roosevelt subsequently asked the Army if the United States was in a position to build 15,000 aircraft a year, should it become necessary to do so. In his State of the Union address in January 1939, Roosevelt stated that the AAC's "antiquated force" of 1,800 aircraft was "utterly inadequate," given the military arsenals that were being built elsewhere, and he urged Congress to embark on an immediate buildup designed to reinforce hemispheric defense. He also observed that the findings of the 1934 Baker board were now "completely out of date."[80] In April, Congress responded by appropriating $300 million for aircraft acquisition, which would allow the AAC to field a force of 5,500 aircraft. The fact that the AAC was assigned a major role in hemispheric defense was especially important because it gave the AAC a military justification for building long-range bombers.[81]

The situation became even more acute in September, when the war in Europe began with the German invasion of Poland. At the time, the AAC had a total of 13 B-17s in service and another 39 on order. In the spring of 1940, Norway, Belgium, and the Netherlands fell to Germany in quick succession, and French forces were reeling from the German blitzkrieg. Roosevelt consequently asked Congress in May to fund a force of 50,000 aircraft and to develop the country's industrial capacity to a point where it could build 50,000 aircraft per year. To put this in context, the U.S. aircraft industry had only built 40,000 aircraft since 1903, and it was then producing around 2,000 aircraft per year; Roosevelt wanted the capacity to build 4,000 per month. In June, British forces

79. Krauskopf, "Army and the Strategic Bomber," pp. 208–215; Greer, *Development of Air Doctrine*, pp. 91–100; Maurer, *Aviation in the U.S. Army*, pp. 402–412; Goldberg, "AAF Aircraft," pp. 203–208.

80. Roosevelt quoted in Goldberg, *History of the United States Air Force*, pp. 44–45, and in Goss, "Origins of the Army Air Forces," p. 10.

81. See Goss, "Origins of the Army Air Forces," pp. 8–9; Cate and Craven, "Army Air Forces," pp. 116–126; Greer, *Development of Air Doctrine*, pp. 76–77, 100–101; Irving B. Holley, Jr., *Buying Aircraft* (Washington: U.S. Army Office of the Chief of Military History, 1964), chap. 8.

were driven off the continent and France fell to Germany. Congressional appropriations for military programs of all kinds subsequently skyrocketed. In the twelve-month period beginning in July 1940, the AAC spent $100 million on research and development alone, and $42 million of this was devoted to long-range bomber programs.[82]

Once the American military buildup began in 1939–1940, the Army stopped being the main constraint on AAC bomber procurement. The problem became the aircraft industry's limited capacity to engage in development and production at breakneck speed. The growing national emergency led the AAC to set aside its traditional acquisition practices, in which research, design development, engineering development, and production took place in an orderly, sequential manner. The AAC began to compress the acquisition process, allowing development and production to overlap.[83] The B-24, B-26, and B-29 were the first major acquisition programs to be guided by this concurrent procurement strategy. Each of these bombers was technologically ambitious, and each experienced procurement problems.

The B-24, Consolidated's counterpart to Boeing's B-17, was designed to fly a 3,000-mile mission at 300 mph with a 9,000-pound payload. Roosevelt's 1939 State of the Union speech led to the first B-24 development contracts in March of that year. Significantly, a production contract for 43 aircraft *preceded* the first flight of a prototype, which took place in December 1939. A production contract for 500 B-24s was signed in the autumn of 1940 even though development of the aircraft was still continuing. Ultimately, a total of 18,190 B-24s were built during the war, the vast majority of which had to go through modification centers before being fielded in order to incorporate the hundreds of changes that were made in the design of the aircraft after it went into production.[84] Extensive retrofitting soon became a hallmark of concurrency.

Martin's B-26 program also got under way in the months after Roosevelt's 1939 speech. Performance requirements for the twin-engine bomber were issued in March, and a design competition led to an AAC decision to buy 201 B-26s in July on the basis of drawing board plans alone. This off-the-shelf procurement strategy, as it was called, involved even more concurrency than the procedure used for the B-24; a bigger commitment to production was made earlier in the development process.[85] Flight testing of the B-26 began in November 1940, and it soon demonstrated serious design problems. Most notably, it had to take off and land at high speed because its relatively small wing generated little lift. This was a dangerous proposition, and five of the first six aircraft delivered to the AAC crashed. Even though extensive modifications were eventually made in the B-26's design—its wingspan and wing area were increased, for example—the "Widow Maker" continued to have a high accident rate. Mechanical defects led a board of officers to ground the entire B-26 fleet at one point during the war. One wartime review identified the program's basic problem: "While it was generally admitted that extensive testing of the B-26 prior to the initiation of a production contract would have furnished a better production airplane, the immediate needs of the Air Corps demanded faster, if more hazardous, procurement."[86] A total of 5,157 medium-range B-26s were built before the need for longer-range bombers in the Pacific led to a cutback in B-26 procurement.

The B-29 program, which the AAC tried to start up in 1938, finally got under way in January 1940, when performance requirements were issued for a heavily armed aircraft that could carry a 2,000-pound payload on a 5,333-mile mission (which would give it a 2,000-mile radius of action) at a speed of 400 mph. A design competition led to an August contract to Boeing to build two B-29 prototypes. A production contract for 500 B-29s was signed in May 1941, and three other manufacturers were brought into the program in February 1942 to begin setting up production lines for the 1,644 aircraft that were then on order. At this point, flight testing of the new bomber had not yet begun. A prototype took to the air in September 1942, which coincided with a production order for 1,000 more B-29s. Although the B-29 did not have serious design flaws comparable to the B-26's, it was nonetheless rushed into production before development of the system and its military subsystems was complete. The B-29, moreover, was technologically ambitious in several respects. For example, it featured a pressurized cabin, remote-control turrets, as well as new engines and propellers. As a result, over 900 design changes had to be made between the time production contracts were first awarded and the first flight of the B-29

82. Goss, "Origins of the Army Air Forces," p. 13; Krauskopf, "Army and the Strategic Bomber," pp. 211, 214; Holley, *Buying Aircraft*, chap. 11; James L. Cate and E. Kathleen Williams, "The Air Corps Prepares for War," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 1, pp. 101–150.

83. For more discussion of the use of concurrency and the problems it caused during World War II, see Tom Lilley et al., *Problems of Accelerating Aircraft Production during World War II* (Boston: Harvard University Graduate School of Business Administration, 1946).

84. Greer, *Development of Air Doctrine*, p. 118; Goldberg, "AAF Aircraft," pp. 206–207; Holley, *Buying Aircraft*, pp. 518–538.



85. See Capt. C. M. Thomas, Materiel Command, "Circular Proposal," March 11, 1939; Brig. Gen. G. H. Brett, Chief, Materiel Division, Letter to Chief of the Air Corps, July 25, 1939; both in B-26 Project, RG 18, Records of the AAF, NARS.

86. Mary L. McMurtrie and Paul M. Davis, *History of the Army Air Forces Materiel Command, 1926–1941*, Historical Study No. 281, Materiel Command, Nov. 1943, p. 88. See also ibid., pp. 86–89; Edward O. Purtee, *Development of Light and Medium Bombers*, Historical Study No. 196, AMC, Dec. 1946, pp. 114–121; Goldberg, "AAF Aircraft," pp. 199–201.

prototype. Three modification centers were set up to make all the post-production changes required in the 3,974 B-29s that were built.[87] (Table 4 provides an overview of the AAC's main bomber programs of the 1930s.)

Doctrinal development in this period was mainly devoted to fleshing out the AAC's theories in greater detail and identifying particular economic target systems for priority attack. By the late 1930s, these theories began to take on a life of their own; combat experiences in Spain, China, and other foreign countries did little to influence the evolution of air doctrine in the United States. When the war in Europe began in 1939, instructors at the Air Corps Tactical School proclaimed that the German air force was demonstrating tactical school theories about the importance of air power, even though German air power doctrine was fundamentally different from the AAC's; the German air force was oriented toward tactical bombing rather than strategic operations.[88]

When the Battle of Britain began in August 1940, air power theorists had the clearest test yet of the effectiveness of different kinds of bombardment tactics. British strategists quickly became convinced that their original inclinations were correct: daylight operations were hazardous and most attacks would have to be made at night if bomber survival rates were to be kept to tolerable levels. The RAF also demonstrated that a strong defense could have a significant impact on the effectiveness of offensive operations. As a result, the number of daylight attacks on both sides decreased as the battle progressed.[89]

Although the Battle of Britain convinced some in the AAC that its ideas about strategic bombardment might have to be modified, most AAC strategists disagreed. As a leading study noted:

> The dominant view at the Tactical School prior to America's entry into World War II was that daylight bombing was essential to the whole precision idea, that bombers would usually have to fly without escort (because of the limited range of pursuit), and that bombers could provide sufficient defensive fire to permit them to accomplish their missions without high losses. . . . Although it is not surprising that Air Corps theorists developed such ideas in the absence of actual tests, what is remarkable is the tenacity with which they held to them even when these ideas were discredited by the experience of the war. . . . The Air Corps held to its theory of daylight, unescorted

87. See *The Superfortress*, Historical Study No. 192, Air Technical Service Command (ATSC), April 1945; James L. Cate, "The VLR Project," in Craven and Cate, eds., *Army Air Force in World War II*, vol. 5, pp. 3–32; Goldberg, "AAF Aircraft," pp. 208–224; Krauskopf, "Army and the Strategic Bomber," p. 211; Swanborough and Bowers, *United States Military Aircraft*, pp. 97–103.

88. Greer, *Development of Air Doctrine*, pp. 101, 109.

89. See E. Kathleen Williams, "The Air War, 1939–1941," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 1, pp. 92–100.

*Table 4.* Major U.S. bomber programs of the 1930s

| Program | Development contract | First flight | Production contract | Number built | Contractor | Main characteristics |
|---|---|---|---|---|---|---|
| B-9 | 1930 | 1931 | — | 7 | Boeing | High-speed, all-metal monoplane |
| B-10 | 1930 | 1932 | 1933 | 152 | Martin | High-speed, all-metal monoplane |
| B-15 | 1935 | 1937 | — | 1 | Boeing | Slow, long-range (5,000 mile) bomber |
| B-17 | 1934 | 1935 | 1936 | 12,726 | Boeing | High-speed, heavily armed bomber |
| B-19 | 1935 | 1941 | — | 1 | Douglas | Slow, long-range (7,800 mile) bomber |
| B-24 | 1939 | 1939 | 1939 | 18,190 | Consolidated | Workhorse bomber; concurrent program |
| B-26 | 1939 | 1941 | 1939 | 5,157 | Martin | Highly concurrent, problem-ridden program |
| B-29 | 1940 | 1942 | 1941 | 3,974 | Boeing | High-speed, long-range bomber; highly concurrent program |

operations by heavy bombers in spite of criticism from the British and reports from its own observers [about the risks inherent in such operations]. One is tempted to believe that the only important lessons "learned" from combat abroad were those which suited the Air Corps; experience which contradicted American doctrine was generally explained away by various kinds of rationalizations.[90]

The AAC argued, for example, that Germany's bombers did not have enough payload or armament to carry out successful strategic bombardment operations. The AAC also argued that Germany did not devote enough bombers to its attacks and that it failed to concentrate on the proper targets. And, although the British were equipped with American-built B-17Cs, the AAC argued that the RAF made mistakes of its own: RAF bomber formations were too small to defend themselves properly, and its bombers flew too high to attack targets with precision. In addition, it was said that inadequate training undermined the effectiveness of the RAF's operations.[91] Although many of these points had merit, the fact of the matter was that unescorted, daylight operations were proving to be much more difficult than AAC strategists had predicted. This was something the AAC was unwilling to accept. As one study observed, "So persuaded were Air Corps planners that their theory of attack was superior that they refused to abandon it even in the face of the hard facts of experience."[92]

As the AAC continued to expand in 1940 and 1941, it became increasingly clear that its formal relationship with the Army would have to be recast. The AAC's burgeoning activities needed to be better coordinated, and something had to be done to reflect the growing emphasis that U.S. military strategy was placing on bombardment operations. In June 1941, the AAC was superseded by the Army Air Forces (AAF), a more self-contained and autonomous body. The chief of the AAF was placed in charge of all Army aviation plans, policies, programs, and perhaps most significant, operational commands. The chief, who was also to be the Army's deputy chief of staff for air, was to be assisted by an Air Staff roughly comparable to the Army's General Staff, which would further strengthen the AAF's independence.[93]

One of the AAF's first tasks was to respond to a presidential request for an outline of its operational plans and production requirements in

90. Greer, *Development of Air Doctrine*, p. 116.
91. Ibid., p. 117; Weigley, *American Way of War*, p. 336.
92. Greer, *Development of Air Doctrine*, p. 117.
93. Maurer, *Aviation in the U.S. Army*, chap. 2; McClendon, *Question of Autonomy*, pp. 190–193; Cate and Williams, "Air Corps Prepares for War," pp. 114–115; Greer, *Development of Air Doctrine*, p. 127.



the event of war. The new Air War Plans Division (AWPD) delivered its report, AWPD/1, to Roosevelt in September. The plan called for a holding action in the Pacific while "tenaciously concentrating all bombing" first on German air force bases and aircraft factories, and then, after German air defenses had been weakened if not neutralized, on 50 German electric power plants, 47 transportation centers, and 27 petroleum industries. The authors of AWPD/1 maintained that "by employing large numbers of aircraft with high speed, good defensive firepower and high altitude, it is feasible to make deep penetrations into Germany in daylight."[94] In the only deviation from traditional thinking, the authors of AWPD/1 called for the immediate development of a long-range escort fighter. They believed that the AAF could carry out this plan if it was equipped with 63,467 aircraft of various kinds.

As 1941 came to a close, bomber advocates in the U.S. military had more organizational autonomy than ever before, a fully developed operational doctrine, and a grand total of 83 B-17s deployed in the continental United States.

## American Air Forces in World War II

In World War I, the American Air Service dropped 275,000 pounds of bombs on German targets. In World War II, the AAF dropped 600,000 *tons* of bombs on Germany and another 147,000 *tons* of bombs on Japan. In addition, the AAF dropped two atomic bombs, each with a yield equal to approximately 15,000 tons of conventional explosives, on Japan in the closing days of the war. Overall, the Allies dropped more than 3,300,000 tons of bombs in Europe and the Pacific during World War II.[95] Bombardment, strategic and otherwise, came of age.

Although a detailed survey of AAF operations in World War II is beyond the scope of this book, brief consideration must be given to the way strategic bombardment doctrine was implemented during the war and the impact it had on the outcome of the war.[96]

94. Quoted in Cate and Williams, "Air Corps Prepares for War," p. 148; Cate, "Plans, Policies, and Organization," p. 600. For more details on AWPD/1, see Cate and Williams, pp. 145–150; Cate, pp. 591–611; Greer, *Development of Air Doctrine*, pp. 123–126.
95. U.S. Strategic Bombing Survey, *Summary Report (Pacific War)* (Washington: Government Printing Office, 1946), p. 16.
96. My discussion of AAF operations and activities during World War II is based on Arthur B. Ferguson, "The Daylight Bombing Experiment," "The War against the Sub Pens," "The Casablanca Directive," "Over Germany," and "The CBO Plan," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 2, pp. 209–376; Alfred Goldberg and Arthur B. Ferguson, "POINTBLANK," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 2, pp. 681–706; John E. Fagg, "The Climax of Strategic Operations," in Craven and

One final reorganization took place before AAF bombers saw combat. The Army's air and ground forces were established as coequal commands under the Army chief of staff in March 1942. The changing relationship between air and ground forces was reflected in a War Department field manual, which noted that "land power and air power are co-equal and interdependent; neither is the auxiliary of the other."[97] The Army's air forces had become as autonomous as they could be without moving out of the Army's orbit altogether.

Naturally, the first few months of the war were devoted to building up forces and moving them into the theaters of operations. The AAF's first bombing operation in Europe took place in June 1942, when bombers flew from Egypt against the Ploesti oil fields in Romania. The first mission flown from British air bases came the following August. Despite RAF skepticism about the AAF's plan to bomb during the day, the AAF's initial losses were low. Its attacks were, however, just tentative probes around the lightly defended periphery; it was not yet flying into Germany itself, where air defenses were strong. In October, the Allied high command put German submarine assembly yards and operating bases at the top of the AAF's and RAF's targeting list; it was deemed essential to prevent German submarine forces from disrupting the flow of supplies from the United States to Britain and Allied forces in Africa, even though this would disrupt the AAF's other bombing operations. The high priority given to German submarine forces was reinforced at the Casablanca conference in January 1943, where Allied air force leaders coordinated their plans for attacking Germany. One of the main issues to be decided at Casablanca was whether the AAF would continue daylight bombing operations. RAF leaders were still skeptical about the costs and benefits of attacking during the day, but the situation was still ambiguous enough for AAF leaders to defend their course of action. It was decided that the AAF's and RAF's Combined Bomber Offensive would involve around-the-clock attacks on German targets; AAF forces would attack by day and RAF forces by night.

The bombing campaign was gradually extended into Germany during the first half of 1943, and in June the Combined Bomber Offensive really began. Negotiations between the AAF and RAF led to a revised target-

Cate, eds., *Army Air Forces in World War II*, vol. 3, pp. 715–755; James L. Cate and James C. Olson, "Urban Area Attacks," in Craven and Cate, eds., *Army Air Forces in World War II*, vol. 5, pp. 609–614; R. J. Overy, *The Air War, 1939–1945* (New York: Stein and Day, 1981), chaps. 2–5; Quester, *Deterrence before Hiroshima*, chaps. 7–10; Goldberg, *History of the United States Air Force*, chaps. 5–6; U.S. Strategic Bombing Survey, *Summary Report (Pacific War)*, pp. 15–20; Curtis E. LeMay, *Mission with LeMay* (Garden City: Doubleday, 1965), pp. 346–353.

97. *Command and Employment of Air Power*, Field Manual 100–20, July 21, 1943. For more on the 1942 reorganization, see McClendon, *Question of Autonomy*, pp. 220–226.



ing plan. German submarine facilities, aircraft assembly and aircraft engine factories were still at the top of the overall priority list, but, based on the recommendation of the AAF, German ball bearing factories were identified as the most important industrial targets.

As the Allied offensive focused more on targets in German territory, the AAF began to have trouble with air defenses, especially when its bombers flew beyond the range of Allied fighter escorts. This point was driven home with brutal clarity in August 1943, when the AAF attacked Regensberg, where nearly half of German single-engine fighters were built, and Schweinfurt, the source of half of Germany's ball bearing output. Of the 376 B-17s sent out, 60 were shot down, the vast majority by German fighters. A second assault on Schweinfurt in October was even costlier; 60 of 291 B-17s were lost. These attacks demonstrated, contrary to what American bombardment doctrine had predicted, that deep penetrations by daylight without fighter escorts were too costly. The AAF would not attempt any more attacks of this kind until long-range escorts became available. Unfortunately, due to years of neglect, long-range escorts were slow to make their way to the field. It was not until December 1943 that P-51 escorts were deployed in Europe, and not until the following March that they were equipped with the extra fuel tanks needed to match the B-17's range.

March 1944 represented a turning point in the Combined Bomber Offensive in three respects. First, long-range escorts became available for American B-17s, which enabled them to attack targets deep in German territory without suffering unacceptably high losses. Second, targeting priorities were shifted as the German submarine threat receded; more attention would henceforth be paid to German oil production and railroad facilities. Third, the American buildup allowed the Allies to conduct truly massive attacks on Germany. Allied air forces, which had dropped an average of 6,000 tons of bombs per month in 1942, dropped an average of 131,000 tons per month on German targets in 1944. By April 1945, dozens of German cities had been barraged, the German railway network was crippled, and German oil production was only 5 percent of what it had been at its peak in 1944.

The strategic bomber offensive in the Pacific was slower to develop because long-range B-29s had to be fielded before Japan could be attacked and because, even then, forward bases were needed to bring Japan within range of the B-29. Although some B-29 attacks on Japan were staged from bases in India and China beginning in June 1944, it was not until November that operations were flown from Pacific island bases and the offensive began in earnest. The first few months of the campaign followed traditional guidelines: high-altitude attacks were flown during the day against Japanese aircraft factories and other se-

lected economic targets; conventional explosives were dropped with as much precision as conditions allowed. In March 1945, however, AAF commanders decided on a radical change in tactics: they would arm B-29s with incendiary bombs and send them in at low altitude at night.

Several factors led the AAF to abandon its traditional conception of bombardment operations. Its attacks had not been having a dramatic effect on the Japanese economy. Although Japanese industry was concentrated in few cities, it was scattered widely throughout these cities. Japan had few large factories because much industrial work was done in small shops or homes. Since most Japanese buildings were built with highly flammable materials, incendiary attacks on large urban areas would have more effect on the Japanese economy than selective, conventional attacks on a few targets. Japanese air defenses, though not as formidable as Germany's, were nonetheless extracting a high price from the AAF during the day. Japan had only two units of night fighters, however, and its antiaircraft guns were not very effective. This made night operations especially attractive. Japanese air defenses were in fact so weak at night that it was possible to attack at low altitudes, which improved accuracy and allowed American bombers to carry heavier payloads. And, since the B-29s would not have to carry ammunition for its guns at night, each plane's payload could be increased by 3,200 pounds beyond its normal low-altitude capacity.

Incendiary attacks on Japanese cities proved to be terrifyingly effective. The March 9 attack on Tokyo burned 15.8 square miles of the city and killed 84,000 people. By the end of July, 105 square miles of Japan's six largest cities had been burned, 220,000 people had been killed, and another 380,000 injured. Japanese industrial output was only 40 percent of what it had been in 1944, and it was falling. The AAF's command of the air was bringing Japan to the point of surrender even before atomic bombs were dropped on Hiroshima and Nagasaki in early August.

As far as predicting the way the war would unfold and serving as a useful operational guide, the AAF's strategic bombardment doctrine was off the mark in four important respects. First, strategic bombardment was not as decisive as interwar air power theorists had predicted. In fact, strategic bombardment operations were highly dependent on ground and naval forces during World War II. Germany would have been able to concentrate all its efforts on air forces if it had not been forced to defend itself against Allied armies as well; at a minimum, this would have cut into the effectiveness of Allied air operations over the continent. In the Pacific, the AAF needed the U.S. Army and Navy to secure forward bases for its bombers. That said, it is certainly true that the AAF played a vital role in both theaters. In Europe, AAF bombers softened German defenses and made the Normandy invasion possible;



they undoubtedly made the final thrust into Germany easier. In the Pacific, strategic bombardment made an invasion unnecessary. In the final analysis, the synergistic effects of combined operations were responsible for bringing the war to a decisive conclusion.

Second, the AAF's target selection was not as effective as it could have been. In Europe, the vulnerability of Germany's ball bearing industry was overestimated; the AAF made sixteen attacks on Schweinfurt during the war, with no significant effect on the German war economy. Germany's oil and chemical industries should have been hit sooner and harder; they were not high on the AAF's target list in 1941 and not moved up significantly until 1944. The AAF also failed to appreciate fully that Japan, although an industrialized nation, had a fundamentally different economic makeup from other powers. A distinctive plan of attack was required, but the AAF nonetheless followed its standard operating procedures for several months. At the same time, one has to note that some targeting problems were not the AAF's fault. The decision to make submarine facilities the top priority in 1942–43, which delayed the AAF's strategic bombing campaign, was imposed on the AAF from above, for example. In addition, the AAF frequently had to choose targets on the basis of limited information.

Third, it proved to be much more difficult to attack targets with precision than the AAF had anticipated. Detailed information about target sets was not always available. Bad weather interfered with bombing accuracy. Enemy air defenses hounded AAF bombers. Bomber crews frequently had little training or combat experience. Mechanical failures disrupted operations. Large formations of aircraft were needed for defensive purposes, but large formations of bombers had large bomb patterns, by definition. AAF bombers had to fly at high altitudes to avoid enemy antiaircraft fire, but accuracy deteriorated as altitude increased. Finally, targets were more resistant to damage and easier to disperse than expected.

Last, interwar speculation about bomber invulnerability was simply wrong. Contrary to what many argued in the 1930s and even after the war in Europe began, bombers needed fighter escorts to penetrate heavy air defenses effectively during the day.

## Postwar Developments

In spite of the conclusions forced by battle, AAF leaders believed that the experiences of World War II confirmed their views on the importance of air power in general and strategic bombing in particular. They acknowledged that they were wrong about some details, but they main-

tained that the advent of the atomic bomb made these minor points irrelevant.[98] Postwar war plans and weapon acquisition programs were thus shaped by the same ideas that had guided air force thinking for years.

Several contingency plans to use atomic weapons were developed in the immediate postwar period. In the late 1940s, these plans emphasized that the air force's principal objective was to destroy the war-making capacity of the Soviet Union. Primary targets included power-generating facilities, oil, steel, and aircraft industries, as well as munitions factories and transportation networks. Little attention was paid to conventional forces themselves, which air force strategists had always regarded as second-order objectives. After the Soviet Union tested its first atomic bomb in 1949, air force war plans paid more and more attention to Soviet strategic forces, especially when it became clear that U.S. Navy systems would not be accurate enough to attack these targets. But even then, air force thinking continued to stress the importance of destroying the Soviet Union's war-making capacity in a prompt, massive blow. Prewar bombardment doctrine played an important role in shaping American war plans as the nuclear age unfolded.[99]

Prewar thinking also influenced performance requirements for postwar bombers. Naturally, range requirements continued to be stressed, given that the Soviet Union was the country's new adversary. Air force requirement planners resisted the idea of penetrating Soviet air defenses at very low altitudes at relatively low speeds. Indeed, low-altitude penetration was not given priority until the early 1960s, when the case for high-altitude penetration could no longer be sustained strategically or politically (see Chapter 7). Although payload and accuracy were objectively less important in the nuclear age, they continued to be identified as important by air force leaders. Payload was important in that many bombers were expected to carry conventional as well as atomic bombs. Accuracy was stressed in the late 1940s and early 1950s because atomic weapons still had limited yields. In the late 1950s, accuracy was stressed because bombers continued to be more accurate than intercontinental ballistic missiles (ICBMs) or submarine-launched ballistic missiles

98. For example, see Gen. Carl Spaatz, "Strategic Air Power: Fulfillment of a Concept," *Foreign Affairs* 24 (April 1946), 385–396.

99. This section is based on Desmond Ball, *Targeting for Strategic Deterrence*, Adelphi Paper no. 185 (London: International Institute for Strategic Studies, 1983); David Alan Rosenberg, "American Atomic Strategy and the Hydrogen Bomb Decision," *Journal of American History* 66 (June 1979), 62–68; Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945–1960," *International Security* 7 (Spring 1983), 1–71; Rosenberg, "A Smoking Radiating Ruin at the End of Two Hours: Documents on American Plans for War with the Soviet Union, 1945–1955," *International Security* 6 (Winter 1981–82), 3–38; Fred Kaplan, *The Wizards of Armageddon* (New York: Simon and Schuster, 1983).



(SLBMs); accurate bomb delivery gave bombers a competitive advantage over unmanned systems in American budgetary battles for many years.

An internal reorganization of the AAF led to the creation of the Strategic Air Command (SAC) in March 1946. SAC was given operational responsibility for the AAF's bomber force. In July 1947, passage of the National Security Act established the U.S. Air Force as an independent service and the Department of the Air Force as an independent executive department; the act went into effect in September. The organizational crusade airmen had waged for decades was won.[100]

100. The Department of the Air Force was established in 1947 as an executive department with cabinet-level representation equal to that of the Army and Navy. A secretary of defense was to head the National Military Establishment. In 1949, the position of the secretary of defense was strengthened. The secretary was given a staff, and the Department of Defense was created as an executive department comprising the army, navy, and air force departments. See Herman S. Wolk, *Planning and Organizing the Postwar Air Force, 1943–1947* (Washington: Office of Air Force History, 1984), chaps. 4–6; Paul Y. Hammond, *Organizing for Defense* (Princeton: Princeton University Press, 1961), chap. 9.